

# ***APPENDIX K***

## **AQUATIC PROPERLY FUNCTIONING CONDITIONS MATRIX**

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# MEMORANDUM

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FROM: Tom Reid

SUBJECT: Pacific Lumber HCP/SYP  
: Background Information on HCP for Marbled Murrelet  
*Revision to memo of June 5, 1998*

DATE: September 22, 1998

TRA FILE: CPAL

*This is a revised version of the memo sent June 5, 1998 and discussed in the subsequent June 8 meeting. The revision provides new information, discusses additional tables and figures corrects unclear language, and transmits changes in tables showing old growth redwood in buffers around old growth redwood on public land as available for harvest under the July 1998 HCP. Old growth redwood in buffers is only residual and totals 295 acres, thus the change in the tables is small.*

\* \* \* \* \*

Under the direction of Jim Gaither at the California Resources Agency, I have been working with technical staff of the state and federal wildlife agencies to synthesize the work on marbled murrelet for Palco's HCP. I am transmitting a summary for discussion.

## Introduction

Pacific Lumber (Palco or PL) seeks an incidental take permit for the marbled murrelet and other species based on a proposed HCP. The Headwaters purchase is a corollary of the HCP.

The federally listed range of the marbled murrelet extends from Washington State into central California. The Marbled Murrelet Recovery Plan (1997) delineates six Marbled Murrelet Conservation Zones (MMCZ) based on population distribution. The PL ownership is in the "Southern Humboldt Bioregion" portion of MMCZ4. **(See Figure #1, Marbled Murrelet Conservation Zones and Southern Humboldt Bioregion.)** A portion of the range of the Marbled murrelet has been designated as critical habitat. A 36,973 acre portion of PL's ownership, including Headwaters, is in designated critical habitat. **(See Figure #2, Marbled Murrelet Critical Habitat.)** Humboldt Redwood State Park to the south and Grizzley Creek State Park along the Van Duzen River are also in critical habitat.



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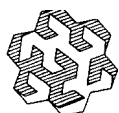
The HCP planning area is a total of 219,298 acres, which includes 209,830 acres of PL land and 9,468 acres of Elk River Timber Company (ERTC) land subject to the Headwaters purchase and land exchange. With the Headwater purchase, 7,478 acres of the planning area would be under public ownership and 211,820 acres would be in PL ownership.

PL's July 1998 HCP proposes establishment of a series of Murrelet Conservation Areas (MCAs) for the life of the permit, and take minimization restrictions on operations elsewhere on PL land. Buffer areas are provided for PL land adjacent to OGR on public land. **Figure #3A, Study Area** and **Figure #3B, Study Area, Enlargement** show the proposed MCAs and their names and the 1/4 mile and 300-foot buffer areas (note that the legend for the A-B figure pairs is on figure A). The July 1998 Draft HCP provides for protection of all MCAs for the 50-year life of the permits, with an option to harvest either the Owl Creek or the Grizzley Creek MCA. Areas within 300 feet of OGR cannot be clear-cut and must maintain a minimum of 240 sq.ft of basal area after harvest. Areas within 1/4 mile are subject to seasonal harvest restriction to avoid murrelet nesting, but may otherwise be clear-cut when harvested.

On August 31, 1998, the California legislature approved inclusion of state funds for Headwaters purchase under Assembly Bill 1986. AB 1986 restricts the use of state funds for Headwaters purchase such that the Owl Creek MCA would be protected for the life of the permit and it provides additional funds for potential state purchase of Owl Creek. AB 1986 requires a 5-year delay in harvest of Grizzley Creek and also provides funds to initiate potential purchase of the Grizzley Creek Complex. Thus, AB 1986 essentially decides PL's "option" of Owl Creek v. Grizzley as "preserve Owl", and it delays and possibly obviates harvest of the Grizzley MCA.

PL's July Draft HCP/SYP application has not been modified in response to the provisions of AB 1986 and the July draft remains the proposed project subject to analysis in the EIS/EIR. The funding restrictions of AB 1986 and the supplemental appropriation for further public purchases will probably be incorporated in the final HCP/SYP. In most of the tables in this memo, totals of preservation or totals of area available for harvest are given for each of the two PL options, and for the possible effect of AB 1986, where neither is harvested.

With the Headwaters purchase and the delineation of the MCA's, most (4,322 acres, 84%) of the uncut (unentered, or virgin) old growth redwood (OGR) on PL's property is set aside from harvest. A substantial amount (at least 3,300 acres, 27%), of lower density residual old growth will not be available for harvest. The MCAs and Headwaters contain some 15,000 acres in total, including about 7,000 acres of second growth. The 300-foot selective harvest buffer includes some 421 acres, with 90 acres of OGR residual. The basal area limitation in the 300-foot buffer may practically prevent harvest of some of the residual present, but because the HCP does not specifically prohibit OGR harvest in the buffers, the revised analysis assumes that it would all be available for harvest.



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The general strategy for the MCAs is to focus conservation on the larger uncut stands or relatively contiguous uncut-residual old growth stands. Stands are buffered and incorporate second growth to improve geometry and increase connectivity - both for biological and management reasons. With Headwaters, the MCAs would protect most (86% with option to cut Owl Creek) of the uncut and residual in critical habitat and add the PL Grizzley Creek complex lands adjacent to the State Park which are now outside of critical habitat to build on the existing old growth in the state and county park and extend protection along the Van Duzen River corridor.

## Habitat

Most of the uncut and some of the residual OGR is occupied or potentially occupied by marbled murrelet and hence harvest would amount to a take of murrelet. The usual means to estimate take in an HCP is by estimating the area of habitat lost. The HCP would allow PL to plan for harvest of roughly two-thirds of the residual OGR on its property. Because the lower density residual is generally believed to be lower quality habitat, it should have a lower probability of occupancy and its harvest should result in a disproportionately lower estimate of take. Further analysis of the effects on residual will be presented in the Draft EIS/EIR.

SPI land involved in the Headwaters purchase does not contain appreciable amounts of OGR timber and no OGR is mapped there. Other OGR timber is found on the ownership outside of the area specifically designated as an OGR forest type, but these trees are scattered so rarely that they do not constitute potential habitat for the marbled murrelet and are not mapped as OGR forest type. **Table #1, Summary of Old Growth Redwood and HCP Status**, shows a summary of OGR forest cover broken down by status under the proposed HCP. Several timber classes are aggregated to show three classes of uncut OGR and two classes of residual OGR. **Figure #4A, Uncut and Residual Old Growth Redwood** and **Figure #4B, Uncut and Residual Old Growth Redwood, Enlargement** shows the distribution of OGR forest cover. **Figure #5A,B Old Growth and Second Growth Forest** shows the MCA and the OGR forest cover in the context of second growth on PL's ownership. Much of the OGR uncut groves are in the central area where harvest over the past two decades leaves the OGR embedded in very young second growth.

In Table 1 .A, page 2, the several HCP options are tallied. Depending on whether Owl Creek, Grizzley Complex, or neither is harvested, all HCP conservation and the Headwaters Forest purchase will protect some 4,321 ac (84%) to 4,638 ac (90%) of uncut, unentered OGR and make available from 501 (10%) to 818 ac (14%) for harvest. Some of that "available" area may be subject to restrictions from the no-cut./selection-cut aquatic buffer. Much more residual is available for harvest.

The majority (96%) of the residual is the low density (under 15 trees per acre). Further classification by timber volume shown in **Figure #6, Old Growth Redwood Timber Volume by Type**, where the various mapping polygons are ordered by the density of redwood timber volume estimated to be present. Timber volume does not



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directly correspond to habitat, but is a further distinction in OGR density. **Table #1 B, Distribution of Old Growth Redwood by Timber Volume by HCP Status** shows the approximate classification of HCP action by timber volume. It shows that the only 4.1% of the OGR residual set aside under HCP MCAs have OGR timber density less than 25 thousand board feet per acre (MBF/ac) whereas 37.7% of the residual available for harvest is in the lower density class. This implies a qualitative distinction: the residual OGR available for harvest has less timber volume because it has fewer trees or smaller trees.

Assessment of canopy shows that two-thirds of the low density residual is less than 25% canopy, with no significant difference between MCAs and the area available for harvest.

**Table #1C, Old Growth Forest Types and HCP Status In- and Outside of Critical Habitat** summarizes the distribution of OGR and other forest types in and outside of the designated critical habitat. It shows that the HCP overall would make 9,430 acres of all OGR available for harvest (with the option to cut Owl Creek)

### **Marbled Murrelet Survey Data**

The PL ownership has been surveyed for murrelet occupancy for 1992 through 1997. Survey data is collected from March through August, hence results for 1998 will not be available until fall. The survey on PL land has been conducted primarily for the purpose of determining whether a specific stand of old growth could be cleared for harvest. The survey was not conducted uniformly or with a design intended to determine the distribution or density of murrelet on the entire property. Survey in nearby Humboldt Redwood State Park (HRSP) has been more uniform in design, but less intense and covers only 1997. **Figure #7A, B Marbled Murrelet Survey Status** show murrelet survey stations and survey status.

The survey stations are reported as “occupied”, “present”, or “not detected”. “Present” indicates that birds were observed, but that reproductive behavior was not observed. See discussion by others.

A OGR stand is deemed “occupied” if any survey station in the stand is observed “occupied” one or more times. The occupied station may lie as far as 200 meters (640 feet) from the edge of the OGR due to the need to place stations in areas suitable for observation. The stand is defined as any contiguous OGR, either uncut or residual, with no more than a 100 m gap of unsuitable habitat in the forest cover. Low density residual or OGR trees lacking proper nest site characteristics may be considered unsuitable. Thus, a forest type map alone cannot specifically show contiguity - that can only be determined in the field.

For the purpose of approving a stand for harvest, an OGR stand is deemed “not occupied” if it is not contiguous with an occupied station and if there are sufficient negative survey results. A negative survey means either four or more survey days with



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no murrelet detections or ten or more survey days with only presence detection. There should be a survey station for every 30 acres of suitable OGR forest in the stand. The determination of habitat suitability and the need for survey reflects qualitative judgement in the field.

The habitat take estimate is based on an estimate of the probable area of PL ownership that is not occupied and hence where harvest would not be a take -- it is not intended to specifically approve any stand for harvest. **Figure #8A,B Marbled Murrelet Survey Status Within 1/2 mile of Survey Stations** gives an indication of murrelet presence overall by drawing a 1/2 mile radius circle out from each survey station. The overlapping circles are in precedence order occupied > present > not detected.

Survey stations are subject to non-uniform effort. As illustrated in **Table #2, Murrelet Survey Counts at Stations, by Result**, most of the "presence" and "not detected" stations are not surveyed to a sufficient intensity to conclude that the stand is not occupied. The protocol allows fewer surveys where several stations are close (overlapping 200m circles). The analysis in Table #2 does not reflect the spatial clustering of stations so some with low survey intensity could have been determined to be non-occupied. Inspection of the map shows that few such clusters still have OGR present.

The uncut and residual old growth redwood can be related to the 1/2 mile survey circles. **Table #3A, Old Growth and Marbled Murrelet Survey Status** is an extensive cross-tabulation of the forest types presented earlier and the survey status in the circles. Data are presented for PL ownership and for Elk River Timber Company (ERTC) land involved in the Headwaters purchase and land exchange. **Table #3B, Forest Type and Marbled Murrelet Survey Status in State Parks** presents similar data for the more than 50,000 acres of adjoining state park land in Humboldt Redwoods and Grizzly Creek Redwoods Parks. The forest typing is different from the categories used on PL land, but the aggregation is comparable.

GIS can calculate contiguity using the rules cited above, but it cannot make the field judgements of continuous habitat in the many areas that are low density residual OGR. Thus, the GIS will consider larger areas as contiguous than may be determined in the field. With strict rule application and survey results through 1997, 11,580 acres of all OGR types are contiguous with an occupied station. **Table #4A, Old Growth Redwood Contiguous to Occupied Stations and Marbled Murrelet Survey Status** overlays the 1/2 mile survey station circles on the GIS analysis of strict contiguity for the various MCA; **Table #4B, Old Growth Redwood Contiguous to Occupied Stations and Marbled Murrelet Survey Status - HCP Summary** give a focused tally for the various conservation options and a percent breakdown.

The distribution of murrelet occupied detections gives an indication of the distribution on PL land, but is clearly non-uniform as to either sample location and sample intensity. In principle, stations with more occupied detections per unit of survey effort may have higher density of murrelet nesting. RSL developed a mean



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standardized occupancy detection, adjusting the number of detections according to a time-of-year detection factor and dividing by the number of standard surveys. The raw result has no direct biological value and we mapped mean detections ordering stations from high to low and grouped them by percentile. **Figure #9, Relative Frequency of Occupied Detection in Marbled Murrelet Surveys** shows stations which are in the highest 10% of all stations by large circles, and stations in lower percentile groups by smaller circle. Because mean occupancy is detections divided by number of surveys, stations with low survey effort tend to score high - or not at all, depending on the chance detection. This may explain why the Humboldt Redwood State Park has so many stations in the top 10%. Nonetheless, the frequency map suggests dense use in the Headwaters and in most of the lesser cathedrals.

## Impact

The projected take of habitat from the HCP depends on assumptions of the extent of occupancy of thousands of acres of low density old growth residuals in the low/no survey areas. **Table #5A, Old Growth Redwood Timber Coverage and Occupancy** summarizes the analysis of the preceding tables and simplifies the allocation of OGR to either "presumed occupied" or "low/no survey". State park data are incorporated to yield a total for Southern Humboldt County. Conservation options are compared with this context.

This compilation leaves three binary variables: location of OGR (PL or State Park), OGR type (uncut or residual), and survey status (presumed occupied or low/no survey). Different assumptions about the likelihood of murrelet occupancy can be made for these different attributes. Two examples are illustrated here.

In **Table #5B, Probability That OGR Habitat is Occupied, based on Survey Status, OGR Type, and Location; Case: Uniform Assumptions**, probability of occupancy factors are tabulated: all "presumed occupied" is 100% likely to be occupied and all "low/no survey" is only 25% likely to be occupied -- regardless of whether the area is uncut or residual type and regardless of whether it is on PL or State Park land. When the probability factors are applied to the distribution of OGR in Table #5A, **Table #5C, Potential Marbled Murrelet Occupied Habitat; Case: Uniform Assumptions** results. The actual area acreages become "potential" habitat when multiplied by the probability factors .

In **Table #5D, Probability That OGR Habitat is Occupied, based on Survey Status, OGR Type, and Location; Case: PL Centered Assumptions**, a different set of assumptions is used. Whereas the previous example was uniform assumptions, these heavily weight PL land: on PL land, all uncut is 100% likely to be occupied, regardless of survey status, but on State Park land, only the presumed occupied is 100% likely and the low/no survey is considered 0% likely to be occupied. A similar skew applies to residual OGR. The results are given in **Table #5E, Potential Marbled Murrelet Occupied Habitat; Case: PL Centered Assumptions**.



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A wide range of assumptions can apply to the simple variable model described here. The overall sensitivity to assumptions is examined in **Table #5F, Effect of Assumptions of Occupancy Probability on Estimates of Take of Occupied Habitat in Southern Humboldt**. There, seven case are compared. The table lists the probability assigned to the variables of location, OGR type, and survey status. Because of the varying assumptions for park land, the total likely occupied acreage for Southern Humboldt varies widely. Because the impact of harvest also varies, the harvest expressed as a percent of Southern Humboldt falls in a fairly narrow range even with widely different assumptions. The reasonable low and high end of this range is 17% to 23%.

Summarizing this series of analyses, we estimate that the loss of OGR allowed under the HCP would amount to from 17% to 23% of the occupied habitat in the Southern Humboldt Bioregion. Work done by C.J. Ralph's team at Redwood Sciences Lab indicate that there is distinctly higher value in the Headwaters and MCAs than in other areas which would be harvested under the HCP. It may be that there is more concentrated Marbled murrelet use in the MCAs and there may be more Marbled murrelet use in the Humboldt Redwood State Park than is assumed, and these conditions would reduce the estimate of habitat take.

The habitat loss on PL land is placed in context by **Table #5G, All Old Growth Redwood Area, and Lower and Higher Occupancy Weighted Estimates of Take, in Context**. Table #5G compares area available for harvest with habitat estimates for MMCZ4 and the three state region. Three perspectives are given, the first column shows the gross OGR area, with no estimate of actual area occupied and no relative weighting of uncut and residual. The next two columns give the lower and the higher occupancy weighted estimates. Because the occupancy weighted estimates change the area values for PL and the State Park, the denominator for Southern Humboldt and for MMCZ4 is adjusted. In context, the lower and higher estimates of habitat loss translate to a 2.6% to 3.7% loss of habitat in MMCZ4 and 0.5% to 0.7% loss of habitat in the three-state range. The weakness of this comparison is the need to assume that OGR habitat on PL land (and in Southern Humboldt) is comparable on an acre-for-acre basis with other, typically non-redwood habitat elsewhere.

Loss of terrestrial nesting habitat will have population impacts, but the nature of the effect is not easily predicted. Different conjecture leads to predictions of either minimal effect or catastrophic effect. The simplest assumption is that there is a one-to-one relationship between habitat loss and the corresponding steady-state population at-sea. Estimating the equivalent number of adult birds corresponding to terrestrial habitat loss is not directly meaningful because it does not mean that this number of birds will be "taken" as individuals.

The equivalent number of adult birds does allow an alternative way to compare impact on Southern Humboldt with the remainder of the range. **Table #5H, Population-based Estimates of Take, in Context** takes the lower and higher percentage estimates for habitat loss and applies them to the assumed 1,479



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population estimate for the Southern Humboldt Bioregion, at-sea. The resulting population estimate “subject to harvest” can be compared against population estimates for MMCZ4 and the three-state range. This form of comparison allows a somewhat speculative population impact on PL land to be compared directly with population estimates elsewhere and side-steps the problem of comparability of habitat across the range.

**Table #5I, All Old Growth Redwood Area, and Lower and Higher Occupancy Weighted Estimates of Take, in Context - Harvest Neither Owl or Grizzley and Table #5J, Population-based Estimates of Take, in Context - Harvest Neither Owl or Grizzley** apply the same analysis to the scenario created by AB 1986 where neither Owl or Grizzley would be harvested. The higher and lower occupied habitat loss falls from 3,200 to 4,800 acres down to 2,900 to 4,200 acres, or expressed as a proportion of Southern Humboldt County, from a range of 17% to 23% down to 16% to 20%.

### **Alternative 4 (“63k”)**

The EIS/EIR analyzes the effect of establishing a much larger reserve around the Headwaters Forest roughly corresponding to critical habitat. This reserve would be some 63,700 acres (“63k”) and is named Alternative 4 in the EIS/EIR. **Tables 6.A through 6.E** recapitulate the analysis of take for the proposed HCP for Alternative 4.

Alternative 4 would preserve slightly more uncut OGR than the HCP (4,651 ac compared with from 4,321 to 4,638 ac), but would add 2,300 to 2,800 ac of residual. Table 6. A and 6. B show that the total acreage of all OGR types (uncut and residual) available for harvest under Alternative 4 would be 6,880 ac or 39% of all OGR on PL land, 17% of all OGR in Southern Humboldt.

Applying the estimated likelihood of murrelet occupancy methodology, we estimate that Alternative 4 would allow harvest of from 2,200 to 3,400 acres of occupied habitat, all outside of critical habitat. This corresponds to a take of from 12% to 16% of habitat in Southern Humboldt County. In context, the lower and higher estimates of habitat loss translate to a 1.8% to 2.7% loss of habitat in MMCZ4 and 0.3% to 0.5% loss of habitat in the three-state range. Using the equivalent population, the take estimate for the three-state range is 0.6% to 1.4% (Table 6.E).

### TSR



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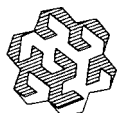
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**Pacific Lumber HCP**

**1. A Summary of Old Growth Redwood and HCP Status**

Area in acres

	Other	OG Doug Fir	REDOG w1	REDOG w2	REDOG w3	All Uncut OGR	REDRSD 2	REDRSD 3	All Residual	All OGR	Total Area
<b>PL Lands</b>											
<b>Avail for Harvest</b>	176,225	8,304	203	217	81	501	264	8,057	8,321	8,823	193,352
<b>Buffer Zones</b>											
buf1320	1,632					0		205	205	205	1,837
buf300	331					0		90	90	90	421
<b>MCA Options</b>											
Grizzley	410		73	44		117	48	482	530	647	1,057
Owl Crk	350	19	240	77		317	10	230	239	556	925
<b>MCA Reserve</b>											
Allen Crk	740		267	68	59	393	20	575	595	988	1,729
B Rd 7&9	232				21	21	14	224	239	260	492
Bell Lawrence	187		315	24		339		107	107	446	634
Booths Run	403	166				0	1	215	216	216	784
Cooper Mill	307					0	151	245	397	397	704
Elkhead Residual	286					0		65	65	65	351
LNF Elk	214					0	36	201	237	237	451
Rd 3	189					0	19	355	374	374	564
Rt Rd 9	128		71		6	77		112	112	190	318
Shaw Gift	162	31	250	6		255		54	54	310	503
MCA reserve Subtotal	2,849	197	902	98	86	1,087	242	2,155	2,397	3,483	6,529
<b>HCP Reserve Options</b>											
Preserve Grizzley	3,259	197	976	142	86	1,204	290	2,636	2,927	4,131	7,586
Preserve Owl	3,199	216	1,142	175	86	1,404	252	2,384	2,636	4,040	7,454
Preserve Both	3,609	216	1,215	220	86	1,521	300	2,866	3,166	4,687	8,511
<b>Headwaters</b>	1,927		2,288	584	245	3,117	0	664	665	3,782	5,709
<b>PL TOTAL</b>	<b>183,724</b>	<b>8,519</b>	<b>3,706</b>	<b>1,021</b>	<b>413</b>	<b>5,139</b>	<b>565</b>	<b>11,882</b>	<b>12,447</b>	<b>17,586</b>	<b>209,830</b>

1. A (Continued)

	Other	OG Fir	Doug W1	REDOG w 2	REDOG w 3	All Uncut OGR	REDRSD 2	REDRSD 3	All Residual	All OGR	Total Area
<b>ERTC Lands</b>											
<b>Avail for Harvest</b>	7,674					0			0	0	7,674
<b>Buffer Zones</b>											
buf300	26					0			0	0	26
<b>Headwaters</b>	1,769					0			0	0	1,769
ERTC Conserved	1,769		0	0	0	0	0	0	0	0	1,769
ERTC TOTAL	9,469					-0				0	9,469
<b>HCP Study Area TOTAL</b>	<b>193,193</b>	<b>8,519</b>	<b>3,706</b>	<b>1,021</b>	<b>413</b>	<b>5,139</b>	<b>565</b>	<b>11,882</b>	<b>12,447</b>	<b>17,586</b>	<b>219,299</b>
<b>ALL HCP and Purchase Conservation</b>											
Preserve Grizzly	6,955	197	3,264	726	332	4,321	291	3,301	3,591	7,913	15,064
Preserve Owl	6,895	216	3,430	759	332	4,521	252	3,049	3,301	7,822	14,932
Preserve Both	7,305	216	3,503	803	332	4,638	301	3,530	3,831	8,469	15,989
<b>ALL Available for Harvest</b>											
Option Cut Grizzly	186,299	8,304	276	262	81	619	312	8,834	9,146	9,765	204,367
Option Cut Owl	186,238	8,323	442	295	81	818	274	8,582	8,855	9,674	204,235
Cut Neither	185,889	8,304	203	217	81	501	264	8,352	8,616	9,117	203,310

Notes for Summary of Old Growth Redwood and HCP Status

Avail for Harvest	Available for harvest planning, not taking into account watercourse protection
Buffer Zones	Restricted harvest to protect adjacent old growth habitat on public lands.
buf1320	within 1/4 mile of HRSP, seasonal restrictions only, can be clearcut.
buf300	within 300 feet of old growth off-site, 240 sf basal area selective harvest, cannot be clearcut.
MCA	Murrelet Conservation Area per boundaries of July 1998 HCP.
MCA Options	Either Owl Crk MCA or Grizzly Creek MCA would be available for harvest if the other is conserved.
Headwaters	Proposed Headwaters purchase area.
ERTC TOTAL	Elk River Timber Company lands involved in Headwaters purchase/land exchange.
ALL HCP and Purchase Conservation Area	with old growth redwood protected under the Headwaters purchase and PL HCP. Excludes buffer areas.
Old Growth Redwood (OGR)	EDOGW1 Uncut, Canopy over 75% cover
	REDOGW2 Uncut, Canopy 50% to 75%
	REDOGW3 Uncut, Canopy under 50%
	REDRSD2 Residual 15 to 30 trees per acre
	REDRSD3 Residual under 15 trees per acre
	No area is mapped with over 30 residual trees per acre

# **Pacific Lumber HCP**

## **1. B Distribution of Old Growth Redwood by Timber Volume Density (Mbf/ac) by HCP Status**

### **Area (acres) in OGR Timber Density Class**

		<b>Mbf/ac:</b>	<b>&lt;25</b>	<b>25to50</b>	<b>50to100</b>	<b>100 to 150</b>	<b>150 to 200</b>	<b>&gt;200</b>	<b>Total</b>
Uncut OGR									
	Available		0	54	81	578	94	11	818
	HCP		0	11	86	984	123	0	1,204
	HW		0	13	245	510	1,480	870	3,117
	Total		0	77	413	2,072	1,698	880	5,140
Residual OGR									
	Available		3,357	5,339	192	7	0	0	8,895
	HCP		120	2,557	250	0	0	0	2,927
	HW		0	615	50	0	0	0	665
	Total		3,477	8,511	492	7	0	0	12,487

### **Percent of Total for HCP Status Category in each Density Class (Percent of Row)**

Uncut OGR									
	Available		0.0%	6.6%	9.9%	70.7%	11.5%	1.3%	100.0%
	HCP		0.0%	0.9%	7.2%	81.7%	10.2%	0.0%	100.0%
	HW		0.0%	0.4%	7.9%	16.3%	47.5%	27.9%	100.0%
Residual OGR									
	Available		37.7%	60.0%	2.2%	0.1%	0.0%	0.0%	100.0%
	HCP		4.1%	87.4%	8.5%	0.0%	0.0%	0.0%	100.0%
	HW		0.0%	92.5%	7.5%	0.0%	0.0%	0.0%	100.0%

### **Percent of each Density Class in HCP Status Category (Percent of Column)**

Uncut OGR									
	Available		69.4%	19.7%	27.9%	5.6%	1.2%	15.9%	
	HCP		14.1%	20.9%	47.5%	7.2%	0.0%	23.4%	
	HW		16.5%	59.4%	24.6%	87.2%	98.8%	60.7%	
			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	
Residual OGR									
	Available		96.6%	62.7%	39.0%			71.2%	
	HCP		3.4%	30.0%	50.8%			23.4%	
	HW		0.0%	7.2%	10.2%			5.3%	
			100.0%	100.0%	100.0%			100.0%	

Available reflects option to cut Owl Crk

HCP is area conserved under proposed permit and excludes buffers.

HW is Headwaters purchase

Timber volume data are from the Oct 97 coverage, updated to Mar 98 by TRA.

The "update" includes some 40 acres of area shown as residual OGR which is "other", not OGR in the Mar98 coverage. For consistency, the sum of residual OGR is 12,447 ac.

**Pacific Lumber HCP**

**1. C Old Growth Forest Types and HCP Status in-and-outside of Critical Habitat**

	Other	OG Doug Fir	REDOG W1	REDOG W2	REDOG W3	All Uncut OG	REDRSD 2	REDRSD 3	All Residual	All OGR	Total Area
<b>Area (acres) of Each Forest Type In- or Not in- Critical Habitat</b>											
<b>In Critical Habitat</b>											
Option Cut Grizzly	21,837	31	96	9	14	119	81	1,688	1,769	1,888	23,756
Option Cut Owl	22,178	50	336	84	14	434	91	1,917	2,008	2,442	24,670
Cut Neither	21,837	31	96	9	14	119	81	1,688	1,769	1,888	23,756
TOTAL in Critical Habitat	27,439	254	3,520	756	346	4,621	295	4,364	4,658	9,280	36,973
<b>NOT In Critical Habitat</b>											
Option Cut Grizzly	159,069	8,307	179	253	67	500	231	7,180	7,411	7,911	175,286
Option Cut Owl	158,667	8,307	106	211	67	385	183	6,698	6,881	7,266	174,240
Cut Neither	158,659	8,307	106	209	67	382	183	6,698	6,881	7,264	174,229
TOTAL NOT in Critical Habitat	165,672	8,307	186	265	67	518	270	7,558	7,829	8,347	182,326
<b>All HCP Planning Area, Including Headwaters</b>											
Option Cut Grizzly	180,905	8,338	276	262	81	619	312	8,868	9,180	9,799	199,041
Option Cut Owl	180,845	8,356	442	295	81	818	274	8,616	8,890	9,708	198,909
Cut Neither	180,495	8,338	203	217	81	501	264	8,386	8,650	9,151	197,984
TOTAL in HCP Area	193,111	8,561	3,706	1,021	413	5,140	565	11,922	12,487	17,627	219,298
<b>% of All of Each Forest Type in Available Area which is also in Critical Habitat</b>											
Option Cut Grizzly	11.3%	0.4%	2.6%	0.9%	3.4%	2.3%	14.3%	14.2%	14.2%	10.7%	10.8%
Option Cut Owl	11.5%	0.6%	9.1%	8.2%	3.4%	8.4%	16.1%	16.1%	16.1%	13.9%	11.2%
Cut Neither	11.3%	0.4%	2.6%	0.9%	3.4%	2.3%	14.3%	14.2%	14.2%	10.7%	10.8%
<b>% of All of Each Forest Type within Critical Habitat which is in Available Area</b>											
Option Cut Grizzly	79.6%	12.2%	2.7%	1.2%	4.0%	2.6%	27.5%	38.7%	38.0%	20.3%	64.3%
Option Cut Owl	80.8%	19.6%	9.5%	11.1%	4.0%	9.4%	30.9%	43.9%	43.1%	26.3%	66.7%
Cut Neither	79.6%	12.2%	2.7%	1.2%	4.0%	2.6%	27.5%	38.7%	38.0%	20.3%	64.3%
<b>% of All of Each Forest Type in Entire Study Area which is in Available Area</b>											
Option Cut Grizzly	93.7%	97.4%	7.4%	25.6%	19.7%	12.0%	55.3%	74.4%	73.5%	55.6%	90.8%
Option Cut Owl	93.6%	97.6%	11.9%	28.9%	19.7%	15.9%	48.5%	72.3%	71.2%	55.1%	90.7%
Cut Neither	93.5%	97.4%	5.5%	21.3%	19.7%	9.8%	46.8%	70.3%	69.3%	51.9%	90.3%

Note: Area available for harvest includes buffers, but does not subtract area of watercourse protection.

Option indicates PL option to cut either Owl Crk or Grizzly Complex under July 1998 Draft HCP.

Analysis based on Oct 97 coverage, updated to Mar 98 by TRA, includes 40 acres of residual OGR not in the PL Mar98 coverage.

For consistency with other tables, the sum of residual OGR is 12,447 ac.

## 2. Pacific Lumber HCP

### Marbled Murrelet Survey Counts at Stations, by Result

Number of Surveys	Number of Stations with this number of surveys			Cumulative number of stations			% of all sites in class with this many or more surveys		
	Occupied	Present	Not Detected	Occupied	Present	Not Detected	Occupied	Present	Not Detected
1	35	83	279	35	83	279	100.00%	100.00%	100.00%
2	5	14	62	40	97	341	78.53%	64.22%	40.38%
3	2	10	19	42	107	360	75.46%	58.19%	27.14%
4	4	8	33	46	115	393	74.23%	53.88%	23.08%
5	3	6	9	49	121	402	71.78%	50.43%	16.03%
6	32	38	19	81	159	421	69.94%	47.84%	14.10%
7	7	21	7	88	180	428	50.31%	31.47%	10.04%
8	3	7	22	91	187	450	46.01%	22.41%	8.55%
9	6	3	7	97	190	457	44.17%	19.40%	3.85%
10	15	5		112	195	457	40.49%	18.10%	2.35%
11	4	5	1	116	200	458	31.29%	15.95%	2.35%
12	4	4	3	120	204	461	28.83%	13.79%	2.14%
13	9	8	1	129	212	462	26.38%	12.07%	1.50%
14	19	7	3	148	219	465	20.86%	8.62%	1.28%
15	8	4	1	156	223	466	9.20%	5.60%	0.64%
16	5	1		161	224	466	4.29%	3.88%	0.43%
17	1			162	224	466	1.23%	3.45%	0.43%
18		1		162	225	466	0.61%	3.45%	0.43%
19		1	1	162	226	467	0.61%	3.02%	0.43%
20		1		162	227	467	0.61%	2.59%	0.21%
21			1	162	227	468	0.61%	2.16%	0.21%
22		2		162	229	468	0.61%	2.16%	0.00%
23		2		162	231	468	0.61%	1.29%	0.00%
24	1	1		163	232	468	0.61%	0.43%	0.00%
Class total	163	232	468						
% of all sites	19%	27%	54%						
All Sites	863								

TRA Version 05/20/98

Source: Redwood Sciences Lab, data through 1997.

### Pacific Lumber HCP

### 3. A Old Growth and Marbled Murrelet Survey Status

Area (acres) by Forest Type within ½ mile radius of Survey Sites

[illegible]



### 3. A (Continued)

[illegible]

### 3. A (Continued)

Total		Other	OG Doug Fir	REDOG W1	REDOG W2	REDOG W3	All Uncut OGR	REDRSD 2	REDRSD 3	All Residual	All OGR	Total Area
PL	no restrict	176,225	8,304	203	217	81	501	264	8,057	8,321	8,823	193,352
	buf1320	1,632	0	0	0	0	0	0	205	205	205	1,837
	buf300	331	0	0	0	0	0	0	90	90	90	421
	All MCA	3,609	216	1,215	220	86	1,521	300	2,866	3,166	4,687	8,511
	<i>HCP Subtotal</i>	<i>5,572</i>	<i>216</i>	<i>1,215</i>	<i>220</i>	<i>86</i>	<i>1,521</i>	<i>300</i>	<i>3,161</i>	<i>3,461</i>	<i>4,982</i>	<i>10,769</i>
	HW	1,927	0	2,288	584	245	3,117	0	664	665	3,782	5,709
	<i>MM Cons. Planning</i>	<i>7,499</i>	<i>216</i>	<i>3,503</i>	<i>803</i>	<i>332</i>	<i>4,638</i>	<i>301</i>	<i>3,825</i>	<i>4,125</i>	<i>8,764</i>	<i>16,478</i>
	<b>All PL</b>	<b>183,724</b>	<b>8,519</b>	<b>3,706</b>	<b>1,021</b>	<b>413</b>	<b>5,140</b>	<b>565</b>	<b>11,882</b>	<b>12,447</b>	<b>17,586</b>	<b>209,830</b>
ERTC	no restrict	7,674	0	0	0	0	0	0	0	0	0	7,674
	buf300	26	0	0	0	0	0	0	0	0	0	26
	HW	1,769	0	0	0	0	0	0	0	0	0	1,769
	<i>MM Cons. Planning</i>	<i>1,795</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>1,795</i>
	<b>All ERTC</b>	<b>9,469</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>9,469</b>

Notes: Murrelet "Occupied" takes precedence over "Present", which is over "Not Detected"  
 Thus if an area was within ½ mile of an occupied site and a present site, it is tallied as occupied.  
 Old growth redwood and old growth doug fir are tallied. All other forest cover is under category "other".  
 no restrict No murrelet restrictions on harvest planning, does not take into account watercourse protection  
 buf1320 within 1/4 mile of HRSP  
 buf300 within 300 feet of old growth off-site  
 All MCA In a MCA per boundaries 6.1, does not distinguish HCP Owl Crk v. Grizzley Option.  
*HCP Subtotal* All of HCP conservation provisions for murrelet, includes both Owl and Grizzley MCA  
 HW In Headwaters purchase area  
 ERTC Elk River Timber Company land involved in Headwaters purchase and land exchange  
*MM Cons. Planning* Total area subject to murrelet conservation planning: All MCA and buffers, plus Headwaters  
 TRA Version 09/22/98

**Pacific Lumber HCP**

**3. B Forest Type and Marbled Murrelet Survey Status in State Parks**

Area (acres) of Forest type within ½ mile of murrelet survey stations, by survey status

	Humboldt Redwood St. Park (HRSP)					Grizzley Creek St. Park				
	Not Surveyed	Occupied	Present	Not Detected	TOTAL	Not Surveyed	Occupied	Present	Not Detected	TOTAL
O1	1,945	2,989	2,582	3,935	11,453	187	95	1		283
O2	249	81	200	791	1,321	4				4
OY1	918	708	687	1,982	4,295	5	61	1		67
OY2	799	317	403	1,359	2,879	8				8
<i>Uncut Type</i>	<b>3,913</b>	<b>4,095</b>	<b>3,873</b>	<b>8,067</b>	<b>19,948</b>	<b>204</b>	<b>155</b>	<b>2</b>	<b>0</b>	<b>362</b>
R1	83		10	202	296					
R2	929	96	48	1,397	2,471					
RY1				71	71					
RY2	256	0	55	180	491		25			25
<i>Residual</i>	<b>1,268</b>	<b>96</b>	<b>113</b>	<b>1,851</b>	<b>3,328</b>	<b>0</b>	<b>25</b>	<b>0</b>	<b>0</b>	<b>25</b>
All OGR	<b>5,181</b>	<b>4,191</b>	<b>3,986</b>	<b>9,918</b>	<b>23,276</b>	<b>204</b>	<b>181</b>	<b>2</b>	<b>0</b>	<b>387</b>
N	6,948	786	260	2,002	9,996	350	83	10	19	462
NC	686			590	1,276					
P	6,453	137	149	2,992	9,730	32	2		2	36
Y1	1,751	243	57	1,078	3,129	69			2	71
Y2	1,082	53	27	541	1,702	3				3
Other	16,919	1,218	494	7,202	25,833	455	85	10	23	572
All Area	<b>22,099</b>	<b>5,410</b>	<b>4,480</b>	<b>17,120</b>	<b>49,109</b>	<b>659</b>	<b>265</b>	<b>12</b>	<b>23</b>	<b>959</b>

**Summary: Both State Parks**

	Not Surveyed	Occupied	Present	Not Detected	TOTAL
Uncut Type	4,117	4,250	3,875	8,067	20,310
Residual	1,268	122	113	1,851	3,354
All OGR	5,385	4,372	3,988	9,918	23,663

**Pacific Lumber HCP**

**4. A Old Growth Redwood Contiguous to Occupied Stations and Marbled Murrelet Survey Status**

Survey Status within ½ mile radius of Survey Stations

			Not OG Redwood	All OGR Contiguous with Occupied Station					Old Growth Redwood, Not Contiguous					TOTAL	
				Occupied	Present	Not Detected	Not Surveyed	TOTAL	Occupied	Present	Not Detected	Not Surveyed	TOTAL		
PL	no restrict		184,529	2,090	916	111	31	3,148	161	547	3,415	1,552	5,675	193,352	
	buf1320		1,632	106	10		116		63	4	22	89	1,837		
	buf300		331	37			37		43	8	1	53	421		
	grv	Allen Crk	740	907	47	33	1	988						1,729	
		B Rd 7&9	232	243	17			260						492	
		Bell Lawrence	187	425	9		13	446						634	
		Booths Run	568	161	55			216						784	
		Cooper Mill	307	364	24	0		389	3	3	2		8	704	
		Elkhead Residual	286	65				65						351	
		Grizzley	410	465	28		3	496	83	68			151	1,057	
		LNF Elk	214	237	0			237						451	
		Owl Crk	369	522	34			556						925	
		Rd 3	189	373		1	1	374						564	
		Rt Rd 9	128	189	1			190						318	
		Shaw Gift	193	310				310						503	
		MCA Subtotal	3,824	4,260	216	34	17	4,527	86	72	2		160	8,511	
		HW	hdwtr	1,927	3,253	308	152	39	3,752	1	5	5	19	30	5,709
	TOTAL		192,244	9,747	1,450	297	86	11,580	248	730	3,434	1,594	6,006	209,830	
	ERTC	no restrict		7,674											7,674
		buf300		26											26
hdwtr		hdwtr	1,769											1,769	
TOTAL		9,469											9,469		
HCP Study Area			201,713	9,747	1,450	297	86	11,580	248	730	3,434	1,594	6,006	219,299	

Notes: Murrelet Occupied takes precedence over Present, which takes precedence over Not Detected  
Thus if an area was within ½ mile of an occupied site and a present site, it is tallied as occupied.  
Only old growth redwood is tallied. All other cover is under category "other".  
OGR Includes both uncut and residual Old Growth Redwood.  
no restrict No murrelet restrictions on harvest planning, does not take into account watercourse protection.  
buf1320 Seasonal harvest restrictions within 1/4 mile of HRSP.  
buf300 Selection cut (no clear-cut) within 300 feet of public old growth redwood off-site.  
ERTC Elk River Timber Company land involved in Headwaters purchase and land exchange

#### 4. B Pacific Lumber HCP

##### Old Growth Redwood Contiguous to Occupied Stations and Marbled Murrelet Survey Status — HCP Summary

Survey Status within ½ mile radius of Survey Stations

Available for Harvest		Not OG Redwood	OGR Contiguous with Occupied Station					Old Growth Redwood, Not Contiguous					TOTAL
			Occupied	Present	Not Detected	Not Surveyed	TOTAL	Occupied	Present	Not Detected	Not Surveyed	TOTAL	
PL	no restriction	184,529	2,090	916	111	31	3,148	161	547	3,415	1,552	5,675	193,352
	all buffers	1,963	143	10	0	0	153	0	106	12	24	142	2,258
	HCP Harvest Options												
	Grizzley	410	465	28		3	496	83	68			151	1,057
	Owl Crk	369	522	34			556						925
	Harvest Grizzley Option	186,902	2,698	955	111	33	3,797	244	721	3,427	1,576	5,968	196,667
	Harvest Owl Crk Option	186,861	2,755	961	111	31	3,857	161	653	3,427	1,576	5,816	196,535
	Harvest Neither	186,492	2,233	927	111	31	3,301	161	653	3,427	1,576	5,816	195,610
	All HCP Study Area	201,713	9,747	1,450	297	86	11,580	248	730	3,434	1,594	6,006	219,299

OGR Harvest by Status	OGR Contiguous with Occupied Station		Old Growth Redwood, Not Contiguous			All OGR
	All Contig. OGR	w/in ½ mi of Occupied	All Not Contig. OGR	w/in ½ mi of Occupied	Not w/in ½ mi of Surveyed	
Harvest Grizzley Option	3,797	2,698	5,968	244	1,576	9,765
As % of All Study Area	33%	28%	99%	98%	99%	56%
Harvest Owl Crk Option	3,857	2,755	5,816	161	1,576	9,674
As % of All Study Area	33%	28%	97%	65%	99%	55%
Harvest Neither	3,301	2,233	5,816	161	1,576	9,117
As % of All Study Area	29%	23%	97%	65%	99%	52%
All HCP Study Area	11,580	9,747	6,006	248	1,594	17,586

Notes: no restriction  
all buffers  
OGR

No murrelet restrictions on harvest planning, does not take into account watercourse protection.  
300 foot selection cut and 1/4 mile seasonal restriction buffers are considered available for harvest.  
Includes both uncut and residual Old Growth Redwood.

**Pacific Lumber HCP**

**5. A Old Growth Redwood Timber Coverage and Occupancy**

(acres)

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Area Subject to Harvest									
Option Cut Grizzley	213	406	619	2,485	6,661	9,146	2,698	7,067	9,765
Option Cut Owl	449	369	818	2,306	6,549	8,856	2,755	6,919	9,674
Cut Neither	150	351	501	2,083	6,533	8,616	2,233	6,884	9,117
Context Area									
PL not HW	1,587	436	2,022	4,907	6,875	11,782	6,493	7,311	13,804
HW	2,643	474	3,117	610	55	665	3,253	529	3,782
All PL	4,230	910	5,139	5,517	6,930	12,447	9,747	7,840	17,586
St Park	4,250	16,059	20,310	122	3,232	3,354	4,372	19,291	23,663
So Hum	8,480	16,969	25,449	5,639	10,162	15,800	14,119	27,131	41,250
Harvest									
As % of PL not HW									
Option Cut Grizzley	13.4%	93.2%	30.6%	50.6%	96.9%	77.6%	41.6%	96.7%	70.7%
Option Cut Owl	28.3%	84.8%	40.5%	47.0%	95.3%	75.2%	42.4%	94.6%	70.1%
Cut Neither	9.4%	80.7%	24.8%	42.5%	95.0%	73.1%	34.4%	94.2%	66.0%
As % of All PL									
Option Cut Grizzley	5.0%	44.6%	12.0%	45.0%	96.1%	73.5%	27.7%	90.1%	55.5%
Option Cut Owl	10.6%	40.6%	15.9%	41.8%	94.5%	71.1%	28.3%	88.3%	55.0%
Cut Neither	3.5%	38.6%	9.8%	37.8%	94.3%	69.2%	22.9%	87.8%	51.8%
As % of So Hum									
Option Cut Grizzley	2.5%	2.4%	2.4%	44.1%	65.5%	57.9%	19.1%	26.0%	23.7%
Option Cut Owl	5.3%	2.2%	3.2%	40.9%	64.4%	56.0%	19.5%	25.5%	23.5%
Cut Neither	1.8%	2.1%	2.0%	36.9%	64.3%	54.5%	15.8%	25.4%	22.1%

Available for harvest does not reflect restrictions in public OGR buffers and watercourse protection zones.

TRA Version 09/08/98

**Pacific Lumber HC**

**5. A rev Old Growth Redwood Timber Coverage and Occupancy – Revision changes: Area in Buffers Removed**

	Uncut OGR			Residual OGR			All Residual	All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey			Presumed Occupied	Low/No Survey	All OGR
Option Cut Grizzly	0	0	0	(143)	(152)	(295)		(143)	(152)	(295)
Option Cut Owl	0	0	0	(143)	(152)	(295)		(143)	(152)	(295)

In application, harvest of Grizzly Creek MCA under option would be subject to 300 foot buffer around OGR in State Park.  
 TRA Version 09/08/98

**Pacific Lumber HCP**

**5. B Probability That OGR Habitat is Occupied based on Survey Status, OGR Type, and Location**

**Case 1: Uniform Assumptions — All Low/No Survey is 25% probability**

OGR Type:	Uncut OGR		Residual OGR	
Survey Status:	Presumed Occupied	Low/No Survey	Presumed Occupied	Low/No Survey
Option Cut Grizzly	100%	25%	100%	25%
Option Cut Owl	100%	25%	100%	25%
PL not HW	100%	25%	100%	25%
HW All PL	100%	25%	100%	25%
State Park	100%	25%	100%	25%

TRA Version 07/31/98



**Pacific Lumber HCP**

**5. C Potential Marbled Murrelet Occupied Habitat**

**Case 1: Uniform Assumptions — All Low/No Survey is 25% probability**

(acres of occupied habitat)

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Area Subject to Harvest									
Option Cut Grizzly	213	101	314	2,485	1,665	4,150	2,698	1,767	4,465
Option Cut Owl	449	92	541	2,306	1,637	3,944	2,755	1,730	4,485
Cut Neither	150	88	238	2,083	1,633	3,716	2,233	1,721	3,954
Context Area									
PL not HW	1,587	109	1,695	4,907	1,719	6,626	6,493	1,828	8,321
HW	2,643	119	2,762	610	14	624	3,253	132	3,385
All PL	4,230	227	4,457	5,517	1,732	7,249	9,747	1,960	11,706
St Park	4,250	4,015	8,265	122	808	930	4,372	4,823	9,195
So Hum	8,480	4,242	12,722	5,639	2,540	8,179	14,119	6,783	20,901
Harvest									
As % of PL not HW									
Option Cut Grizzly	13.4%	93.2%	18.5%	50.6%	96.9%	62.6%	41.6%	96.7%	53.7%
Option Cut Owl	28.3%	84.8%	31.9%	47.0%	95.3%	59.5%	42.4%	94.6%	53.9%
Cut Neither	9.4%	80.7%	14.0%	42.5%	95.0%	56.1%	34.4%	94.2%	47.5%
As % of All PL									
Option Cut Grizzly	5.0%	44.6%	7.0%	45.0%	96.1%	57.3%	27.7%	90.1%	38.1%
Option Cut Owl	10.6%	40.6%	12.1%	41.8%	94.5%	54.4%	28.3%	88.3%	38.3%
Cut Neither	3.5%	38.6%	5.3%	37.8%	94.3%	51.3%	22.9%	87.8%	33.8%
As % of So Hum									
Option Cut Grizzly	2.5%	2.4%	2.5%	44.1%	65.5%	50.7%	19.1%	26.0%	21.4%
Option Cut Owl	5.3%	2.2%	4.3%	40.9%	64.4%	48.2%	19.5%	25.5%	21.5%
Cut Neither	1.8%	2.1%	1.9%	36.9%	64.3%	45.4%	15.8%	25.4%	18.9%

**Pacific Lumber HCP**

**5. D Probability That OGR Habitat is Occupied based on Survey Status, OGR Type, and Location**

**Case 2: PL Centered Assumptions — All PL Uncut OGR is 100%, State Park Low/No Survey is 0% probability**

<b>OGR Type:</b>	<b>Uncut OGR</b>		<b>Residual OGR</b>	
	<b>Survey Presumed Status: Occupied</b>	<b>Low/No Survey</b>	<b>Presumed Occupied</b>	<b>Low/No Survey</b>
Option Cut Grizzly	100%	100%	100%	25%
Option Cut Owl	100%	100%	100%	25%
PL not HW	100%	100%	100%	25%
HW All PL	100%	100%	100%	25%
State Park	100%	0%	100%	0%

TRA Version 07/31/98

Pacific Lumber HCP

5. E Potential Marbled Murrelet Occupied Habitat

Case 2: PL Centered Assumptions — All PL Uncut OGR is 100%, State Park Low/No Survey is 0% probability

(acres of occupied habitat)

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Area Subject to Harvest									
Option Cut Grizzly	213	406	619	2,485	1,665	4,150	2,698	2,071	4,769
Option Cut Owl	449	369	818	2,306	1,637	3,944	2,755	2,007	4,762
Cut Neither	150	351	501	2,083	1,633	3,716	2,233	1,985	4,218
Context Area									
PL not HW	1,587	436	2,022	4,907	1,719	6,626	6,493	2,154	8,648
HW	2,643	474	3,117	610	14	624	3,253	488	3,741
All PL	4,230	910	5,139	5,517	1,732	7,249	9,747	2,642	12,389
St Park	4,250	0	4,250	122	0	122	4,372	0	4,372
So Hum	8,480	910	9,390	5,639	1,732	7,371	14,119	2,642	16,761
Harvest									
As % of PL not HW									
Option Cut Grizzly	13.4%	93.2%	30.6%	50.6%	96.9%	62.6%	41.6%	96.1%	55.1%
Option Cut Owl	28.3%	84.8%	40.5%	47.0%	95.3%	59.5%	42.4%	93.1%	55.1%
Cut Neither	9.4%	80.7%	24.8%	42.5%	95.0%	56.1%	34.4%	92.1%	48.8%
As % of All PL									
Option Cut Grizzly	5.0%	44.6%	12.0%	45.0%	96.1%	57.3%	27.7%	78.4%	38.5%
Option Cut Owl	10.6%	40.6%	15.9%	41.8%	94.5%	54.4%	28.3%	75.9%	38.4%
Cut Neither	3.5%	38.6%	9.8%	37.8%	94.3%	51.3%	22.9%	75.1%	34.0%
As % of So Hum									
Option Cut Grizzly	2.5%	44.6%	6.6%	44.1%	96.1%	56.3%	19.1%	78.4%	28.5%
Option Cut Owl	5.3%	40.6%	8.7%	40.9%	94.5%	53.5%	19.5%	75.9%	28.4%
Cut Neither	1.8%	38.6%	5.3%	36.9%	94.3%	50.4%	15.8%	75.1%	25.2%

Pacific Lumber HCP

5. F Effect of Assumptions of Occupancy Probability on Estimated Take in Southern Humboldt

			Case						
			1	2	3	4	5	6	7
Location	OGR Type	Survey Status	Uniform Assumpt.	PL Centered	All PL Uncut is Occupied	All Uncut is Occupied	Habitat Quality Weight for Uncut	Straight Area: All OGR is Habita	Only Uncut OGR is Habitat
PL Lands, including HW			(Probability of occupancy)						
	Uncut	Presumed Occupied	100%	100%	100%	100%	100%	100%	100%
		Low/No Survey	25%	100%	100%	100%	100%	100%	100%
	Residual	Presumed Occupied	100%	100%	100%	100%	35%	100%	0%
		Low/No Survey	25%	25%	25%	25%	25%	100%	0%
State Park Lands									
	Uncut	Presumed Occupied	100%	25%	100%	100%	100%	100%	100%
		Low/No Survey	25%	0%	25%	100%	25%	100%	100%
	Residual	Presumed Occupied	100%	25%	100%	100%	35%	100%	0%
		Low/No Survey	25%	0%	25%	25%	25%	100%	0%
Harvest Percent			(Take as percent of Southern Humboldt)						
	Option Cut Grizzly		21.4%	28.5%	22.1%	14.2%	17.6%	23.7%	2.4%
	Option Cut Owl		21.5%	28.4%	22.1%	14.2%	18.2%	23.5%	3.2%
	Cut Neither		18.9%	25.2%	19.5%	12.5%	16.0%	22.1%	2.0%
Harvest Area			(Area in acres of Effectively Occupied Habitat)						
	Option Cut Grizzly		4,465	4,769	4,769	4,769	3,154	9,765	619
	Option Cut Owl		4,485	4,762	4,762	4,762	3,263	9,674	818
	Cut Neither		3,954	4,218	4,218	4,218	2,864	9,117	501
Context									
	PL Not HW		8,321	8,648	8,648	8,648	5,458	13,804	2,022
	All PL		11,706	12,389	12,389	12,389	8,803	17,586	5,139
	Southern Humboldt		20,901	16,761	21,584	33,628	17,919	41,250	25,449
				Higher			Lower	All OGR	

**Pacific Lumber HCP**

**5. G All Old Growth Redwood Area, and Lower and Higher Occupancy Weighted Estimates of Take in Context**  
Effective Occupied Habitat (acres, rounded) and Harvest as % of Context

	All OGR		Occupancy Weighted Estimate			
			Lower Estimate		Higher Estimate	
Context	Acres	Harvest %	Acres	Harvest %	Acres	Harvest %
Subject to Harvest	9,700		3,200		4,800	
PL Not HW	13,800	70.3%	5,500	58.2%	8,600	55.8%
All PL	17,600	55.1%	8,800	36.4%	12,400	38.7%
Southern Humboldt	41,200	23.5%	17,900	17.9%	21,600	22.2%
California	90,500	10.7%	67,200	4.8%	70,900	6.8%
MMCZ 4	147,800	6.6%	124,500	2.6%	128,200	3.7%
Three State	700,000	1.4%	700,000	0.5%	700,000	0.7%

Subject to Harvest Rounded values of all harvest, reflecting either Owl or Grizzly cut.

Does not subtract areas within watercourse protection zones.

All OGR Lumps Uncut and Residual OGR forest types (Case 6)

Lower Estimate Reflects 35% habitat quality weighting for Residual OGR (Case 5), rounded.

Higher Estimate All PL Uncut is 100% occupied; State Pk Uncut not w/in ½ mi of occ survey is 25% (Case 3).

Area for Calif. and MMCZ4 adjusted to account for different contribution from Southern Humboldt by case.

**Pacific Lumber HCP**

**5. H Population-based Estimates of Take, in Context**

Estimated Population in Birds and Effect of Harvest as % of Context

Overall Population Range:

**LOW**

**HIGH**

	Lower Estimate of Take		Higher Estimate of Take		Lower Estimate of Take		Higher Estimate of Take	
	Population	Harvest %	Population	Harvest %	Population	Harvest %	Population	Harvest %
Context								
Subject to Harvest	251		340		251		340	
PL Not HW	na							
All PL	na							
Southern Humboldt	1,479	17.0%	1,479	23.0%	1,479	17.0%	1,479	23.0%
California	4,884	5.1%	4,884	7.0%	4,884	5.1%	4,884	7.0%
MMCZ 4	5,560	4.5%	5,560	6.1%	8,134	3.1%	8,134	4.2%
Three State	16,984	1.5%	16,984	2.0%	30,000	0.8%	30,000	1.1%

Subject to Harvest Assumes Option Cut Owl Crk; Does not subtract areas within watercourse protection zones.

Lower Estimate Assumed to be 17% of Southern Humboldt population, based on lower occupied habitat area.

Higher Estimate Assumed to be 23% of Southern Humboldt population, based on higher occupied habitat area.

Pacific Lumber HCP

5. I All Old Growth Redwood Area, and Lower and Higher Occupancy Weighted Estimates of Take in Context  
Effective Occupied Habitat (acres, rounded) and Harvest as % of Context  
Harvest Neither Owl nor Grizzley

	All OGR		Occupancy Weighted Estimate			
	Acres	Harvest %	Lower Estimate		Higher Estimate	
			Acres	Harvest %	Acres	Harvest %
Subject to Harvest	9,100		2,900		4,200	
Context						
PL Not HW	13,800	65.9%	5,500	52.7%	8,600	48.8%
All PL	17,600	51.7%	8,800	33.0%	12,400	33.9%
Southern Humboldt	41,200	22.1%	17,900	16.2%	21,600	19.4%
California	90,500	10.1%	67,200	4.3%	70,900	5.9%
MMCZ 4	147,800	6.2%	124,500	2.3%	128,200	3.3%
Three State	700,000	1.3%	700,000	0.4%	700,000	0.6%

Subject to Harvest Rounded values of all harvest, with neither Owl nor Grizzley cut.

Does not subtract areas within watercourse protection zones.

All OGR Lumps Uncut and Residual OGR forest types (Case 6)

Lower Estimate Reflects 35% habitat quality weighting for Residual OGR (Case 5), rounded.

Higher Estimate All PL Uncut is 100% occupied; State Pk Uncut not w/in ½ mi of occ survey is 25% (Case 3).

Area for Calif. and MMCZ4 adjusted to account for different contribution from Southern Humboldt by case.

**5. J Population-based Estimates of Take, in Context**  
**Estimated Population in Birds and Effect of Harvest as % of Context**  
**Harvest Neither Owl nor Grizzley**

Population Estimate Range:

**LOW**

**HIGH**

	Lower Estimate of Take		Higher Estimate of Take		Lower Estimate of Take		Higher Estimate of Take	
	Population	Harvest %	Population	Harvest %	Population	Harvest %	Population	Harvest %
Context								
Subject to Harvest	237		296		237		296	
PL Not HW	na							
All PL	na							
Southern Humboldt	1,479	16.0%	1,479	20.0%	1,479	16.0%	1,479	20.0%
California	4,884	4.8%	4,884	6.1%	4,884	4.8%	4,884	6.1%
MMCZ 4	5,560	4.3%	5,560	5.3%	8,134	2.9%	8,134	3.6%
Three State	16,984	1.4%	16,984	1.7%	30,000	0.8%	30,000	1.0%

Subject to Harvest Assumes Option Cut Owl Crk; Does not subtract areas within watercourse protection zones.  
 Lower Estimate Assumed to be 16% of Southern Humboldt population, based on lower occupied habitat area.  
 Higher Estimate Assumed to be 20% of Southern Humboldt population, based on higher occupied habitat area.

TRA Version 09/22/98



Pacific Lumber HCP

6. A Conservation Status of Forest Types, ALternative 4 ("63k")

	Status Under Alt. 4	Status Under HCP	Other	OG Doug Fir	REDOGW 1	REDOGW 2	REDOGW 3	All Uncut OGR	REDRSD2	REDRSD3	All Residual	All OGR	Total Area
PL	In Alt 4	avail	42,764	114	96	20	14	131	88	2,705	2,793	2,924	45,802
		300buf	30					0			0	0	30
		grv	3,198	216	1,142	175	86	1,404	252	2,385	2,637	4,040	7,454
		hdwtr	1,927		2,288	584	245	3,117	0	664	665	3,782	5,709
		<b>Alt 4 Subtotal</b>	<b>47,919</b>	<b>330</b>	<b>3,527</b>	<b>779</b>	<b>346</b>	<b>4,651</b>	<b>341</b>	<b>5,754</b>	<b>6,095</b>	<b>10,746</b>	<b>58,995</b>
	out	avail	133,380	8,231	106	197	67	371	176	5,392	5,567	5,938	147,549
		1320buf	1,632					0		205	205	205	1,837
		300buf	301					0		90	90	90	391
		grv	410		73	44		117	48	482	530	647	1,057
	PL Total		183,642	8,561	3,706	1,021	413	5,140	565	11,922	12,487	17,626	209,829
SPI	In Alt 4	avail	3,166					0			0	0	3,166
		300buf	26					0			0	0	26
		hdwtr	1,485					0			0	0	1,485
		<b>Alt 4 Subtotal</b>	<b>4,677</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4,677</b>
	out	avail	4,508					0			0	0	4,508
		hdwtr	284					0			0	0	284
All Alt 4			<b>52,596</b>	<b>330</b>	<b>3,527</b>	<b>779</b>	<b>346</b>	<b>4,651</b>	<b>341</b>	<b>5,754</b>	<b>6,095</b>	<b>10,746</b>	<b>63,672</b>
Subject to Harvest			135,723	8,231	179	242	67	488	224	6,168	6,392	6,880	150,834
Available as % of all PL			74%	96%	5%	24%	16%	9%	40%	52%	51%	39%	72%

Subject to Harvest: PL land only, excludes land in Alt.4 area but does not exclude public OGR buffer or watercourse protection.

**Pacific Lumber HCP**

**6. B Old Growth Redwood Timber Coverage and Occupancy Under Alternative 4 ("63k")**

(acres)

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Subject to Harvest	204	284	488	1,652	4,740	6,392	1,856	5,024	6,880
PL not HW	1,587	436	2,022	4,907	6,875	11,782	6,493	7,311	13,804
HW	2,643	474	3,117	610	55	665	3,253	529	3,782
All PL	4,230	910	5,139	5,517	6,930	12,447	9,747	7,840	17,586
St Park	4,250	16,059	20,310	122	3,232	3,354	4,372	19,291	23,663
So Hum	8,480	16,969	25,449	5,639	10,162	15,800	14,119	27,131	41,250
As % of PL not HW									
Alt 4	12.8%	65.3%	24.1%	33.7%	68.9%	54.3%	28.6%	68.7%	49.8%
As % of All PL									
Alt 4	4.8%	31.3%	9.5%	29.9%	68.4%	51.4%	19.0%	64.1%	39.1%
As % of So Hum									
Alt 4	2.4%	1.7%	1.9%	29.3%	46.6%	40.5%	13.1%	18.5%	16.7%

Pacific Lumber HCP

6. C Lower and Higher Occupancy Estimates Under Alternative 4 ("63k")

	Uncut OGR			Residual OGR			All OGR		
	Presumed Occupied	Low/No Survey	All Uncut	Presumed Occupied	Low/No Survey	All Residual	Presumed Occupied	Low/No Survey	All OGR
Actual Area (acres)	204	284	488	1,652	4,740	6,392	1,856	5,024	6,880
Effective Occupied Area (acres)									
Low: "Case 5"	100%	100%		35%	25%				
Alt 4 Low	204	284	488	578	1,185	1,763	782	1,469	2,251
High: "Case "3"	100%	100%		100%	25%				
Alt 4 High	204	284	488	1,652	1,185	2,837	1,856	1,469	3,325

Lower Estimate

All Uncut OGR is 100% occupied; presumed occupied Residual is given 35% habitat quality occupancy likelihood weighting; Low/No survey Residual OGR is 25% occupied. (Case 5)

Higher Estimate

All PL Uncut and presumed occupied Residual is 100% occupied; Low/No survey Residual is 25% occupied. State Park Uncut not w/in ½ mi of occ survey is 25%. (Case 3)

**Pacific Lumber HCP**

**6. D Old Growth Area, and Lower and Higher Occupancy Weighted Estimates of Take in Context Under Alternative 4 ("63k")**  
Effective Occupied Habitat (acres, rounded) and Harvest as % of Context

	All OGR		Occupancy Weighted Estimate			
	Acres	Harvest %	Lower Estimate		Higher Estimate	
			Acres	Harvest %	Acres	Harvest %
Subject to Harvest	6,900		2,200		3,400	
Context						
PL Not HW	13,800	50.0%	5,500	40.0%	8,600	39.5%
All PL	17,600	39.2%	8,800	25.0%	12,400	27.4%
Southern Humboldt	41,200	16.7%	17,900	12.3%	21,600	15.7%
California	90,500	7.6%	67,200	3.3%	70,900	4.8%
MMCZ 4	147,800	4.7%	124,500	1.8%	128,200	2.7%
Three State	700,000	1.0%	700,000	0.3%	700,000	0.5%
Subject to Harvest	All PL outside of "63k"; Does not subtract buffers or watercourse protection zones.					
All OGR	Lumps Uncut and Residual OGR forest types regardless of occupancy. (Case 6)					
Lower Estimate	Reflects 35% habitat quality weighting for Residual OGR (Case 5)					
Higher Estimate	All PL Uncut is 100% occupied; State Park Uncut not w/in ½ mi of occ survey is 25% (Case 3)					

Area for Calif. and MMCZ4 adjusted to account for different contribution from Southern Humboldt

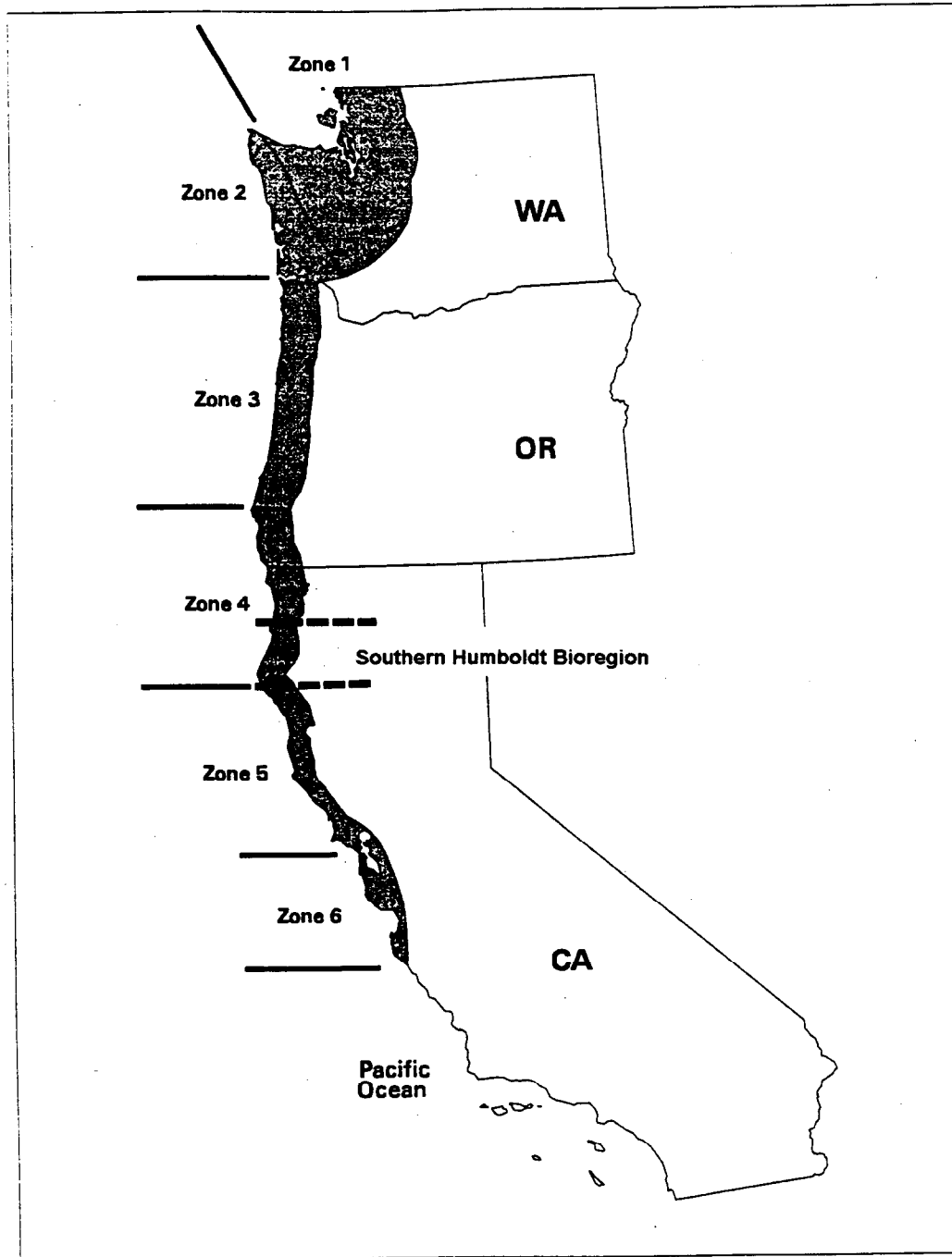
**Pacific Lumber HCP**

**6. E Population-based Estimates of Take, in Context Under Alternative 4 ("63k")**

Estimated Population in Birds and Effect of Harvest as % of Context

Population Estimate Range:		LOW				HIGH			
		Lower Estimate of Take		Higher Estimate of Take		Lower Estimate of Take		Higher Estimate of Take	
		Population	Harvest %	Population	Harvest %	Population	Harvest %	Population	Harvest %
Context	Subject to Harvest	177		237		177		237	
	PL Not HW	na							
	All PL	na							
	Southern Humboldt	1,479	12.0%	1,479	16.0%	1,479	12.0%	1,479	16.0%
	California	4,884	3.6%	4,884	4.8%	4,884	3.6%	4,884	4.8%
	MMCZ 4	5,560	3.2%	5,560	4.3%	8,134	2.2%	8,134	2.9%
	Three State	16,984	1.0%	16,984	1.4%	30,000	0.6%	30,000	0.8%

Subject to Harvest All PL outside of "63k"; Does not subtract buffers or watercourse protection zones.  
 Lower Estimate Assumed to be 12% of Southern Humboldt population, based on lower occupied habitat area.  
 Higher Estimate Assumed to be 16% of Southern Humboldt population, based on higher occupied habitat area.



**Figure 8.** Map of the six Marbled Murrelet Conservation Zones (Zones). See text for descriptions.

Figure #2

**Pacific Lumber HCP  
Marbled Murrelet  
Critical Habitat**

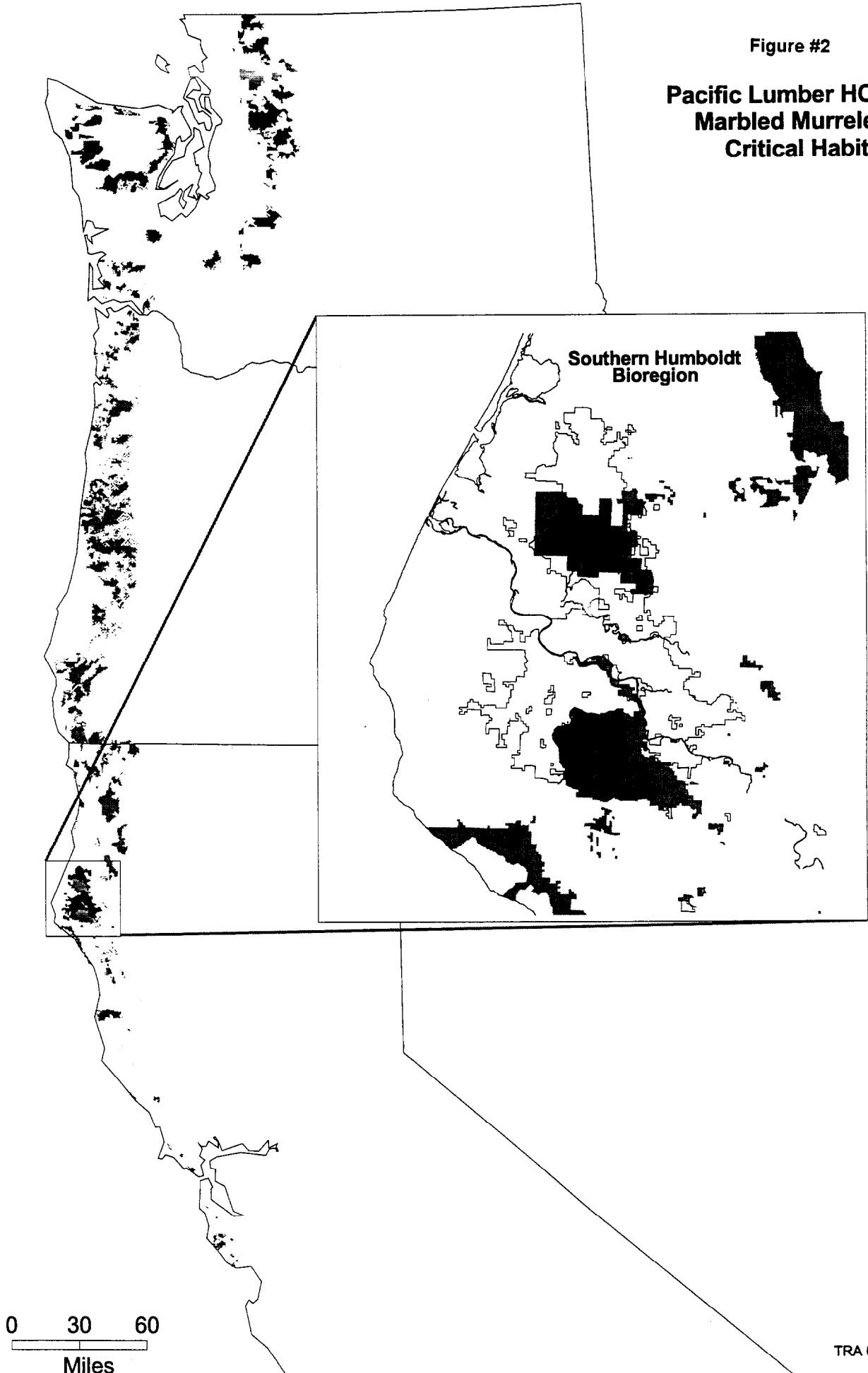


Figure #3A

# Pacific Lumber HCP Study Area

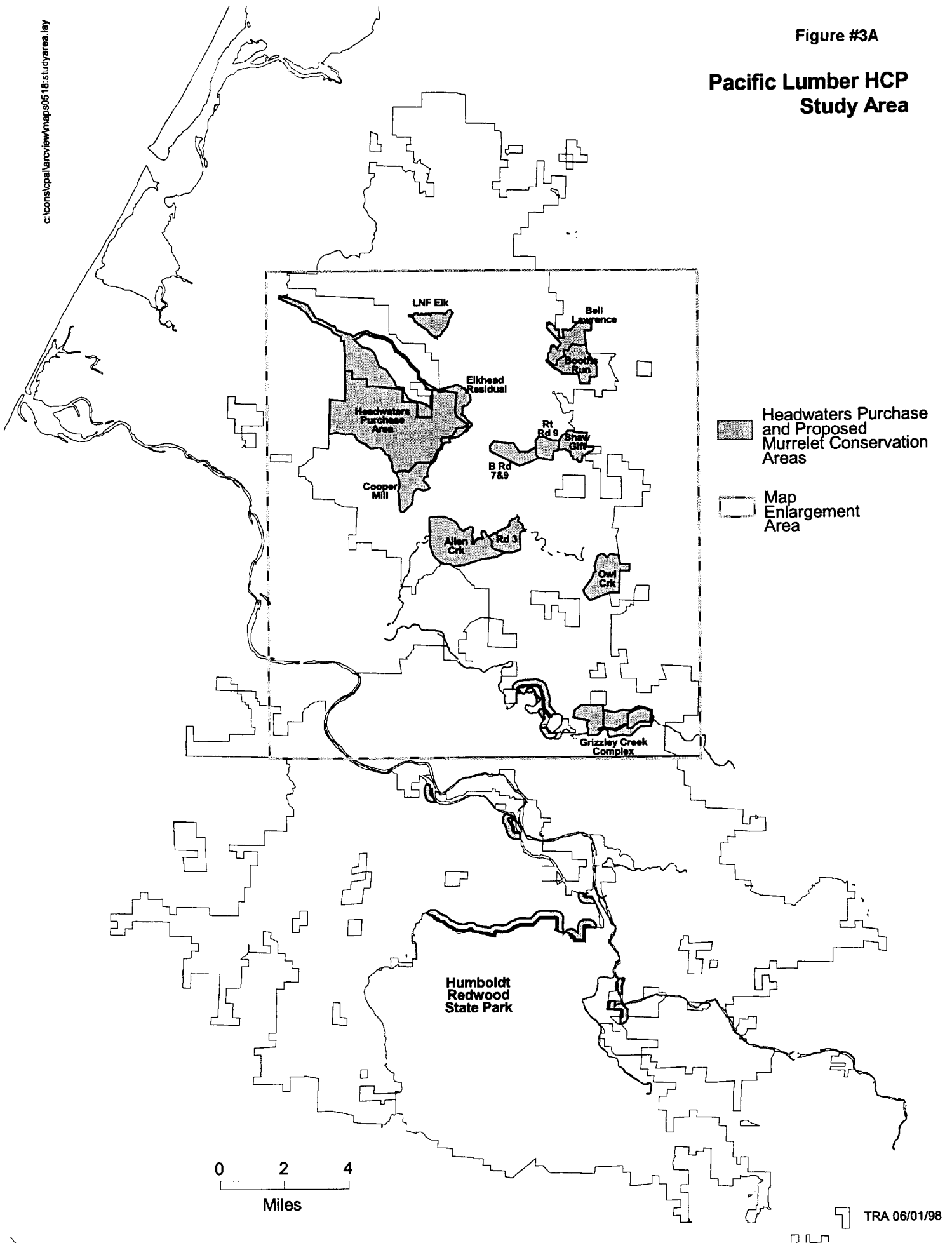




Figure #3B

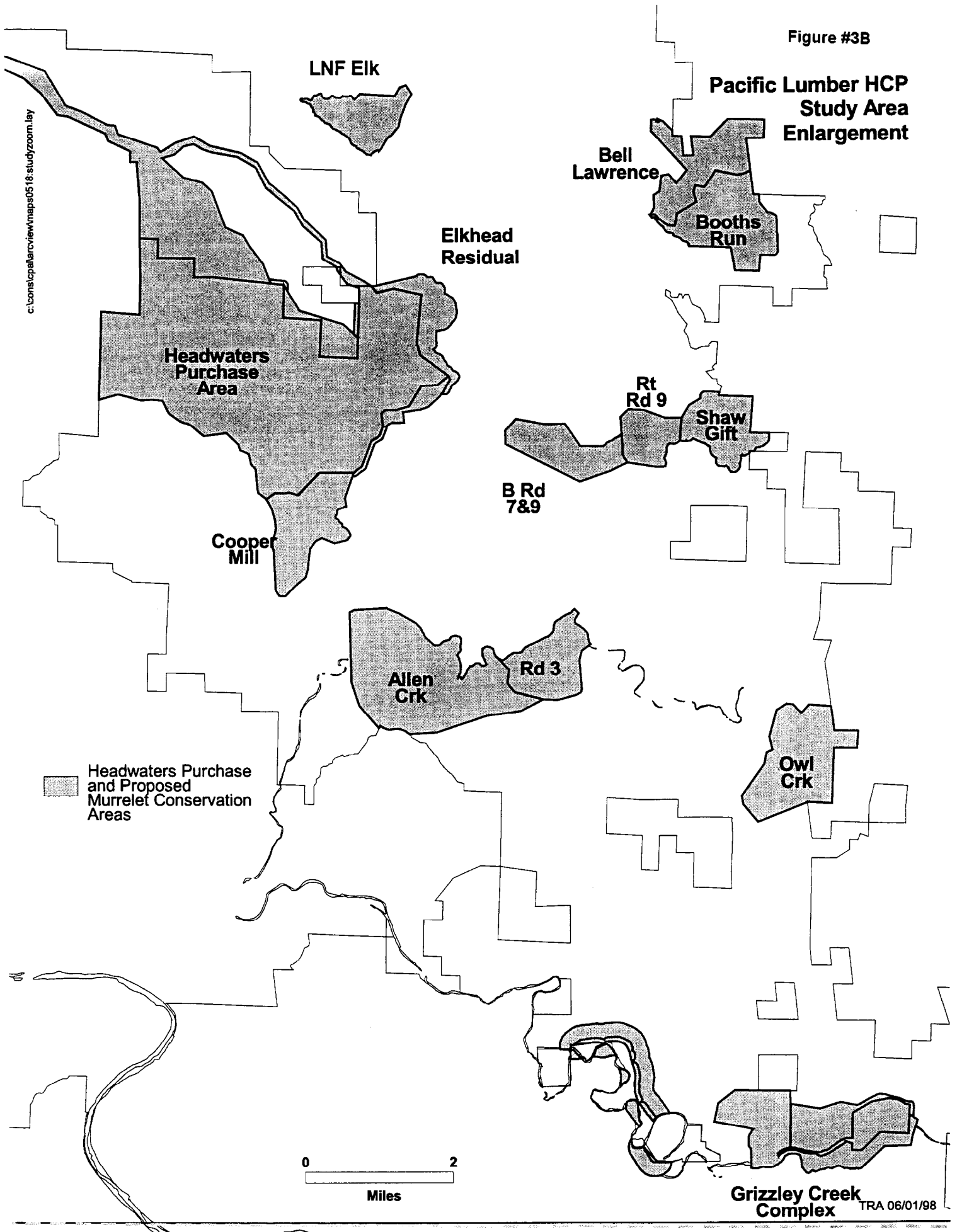


Figure #4A

**Pacific Lumber HCP  
Uncut and Residual  
Old Growth Redwood**

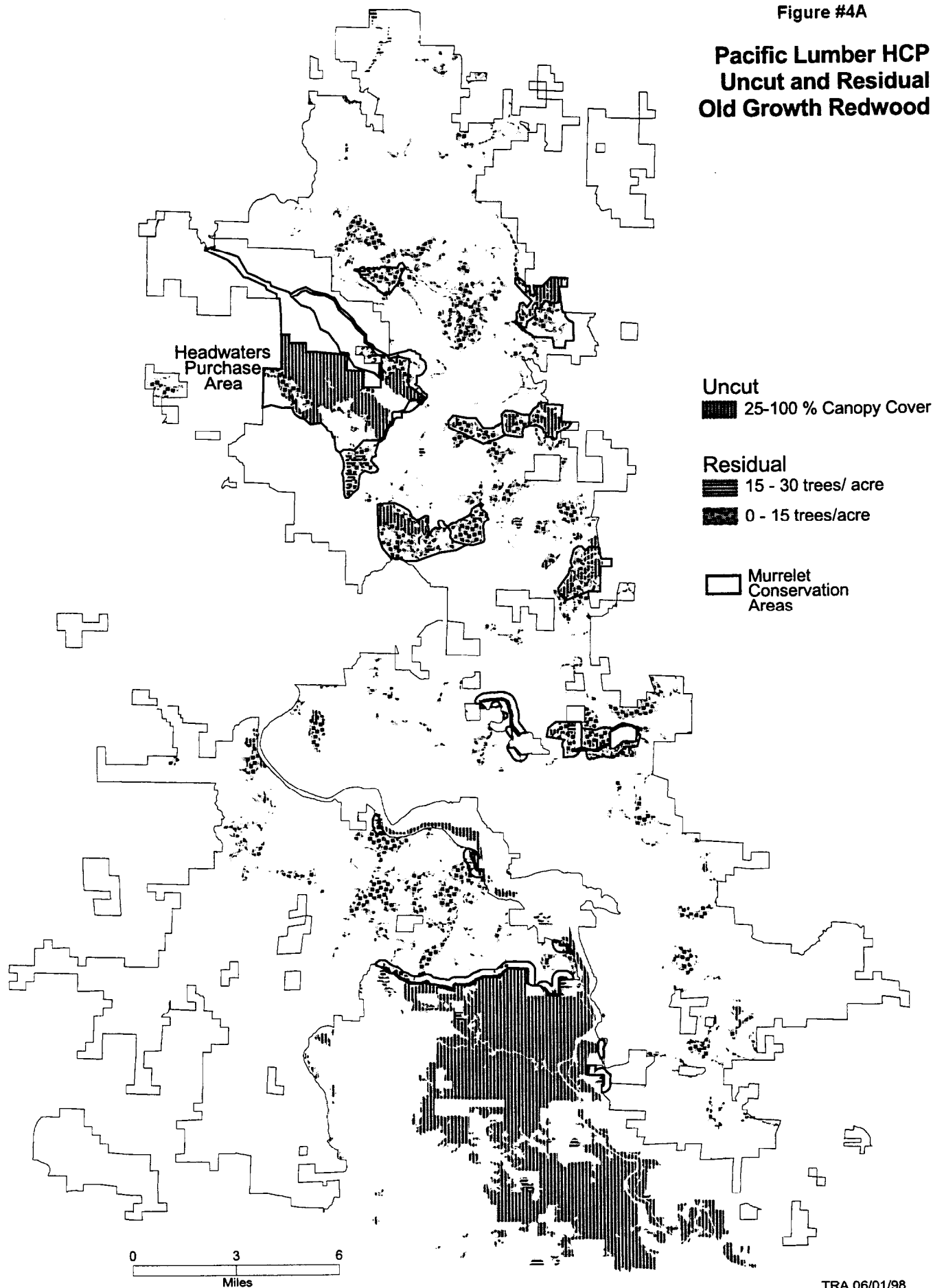


Figure #4B

**Pacific Lumber HCP  
Old Growth Redwood  
Enlargement**

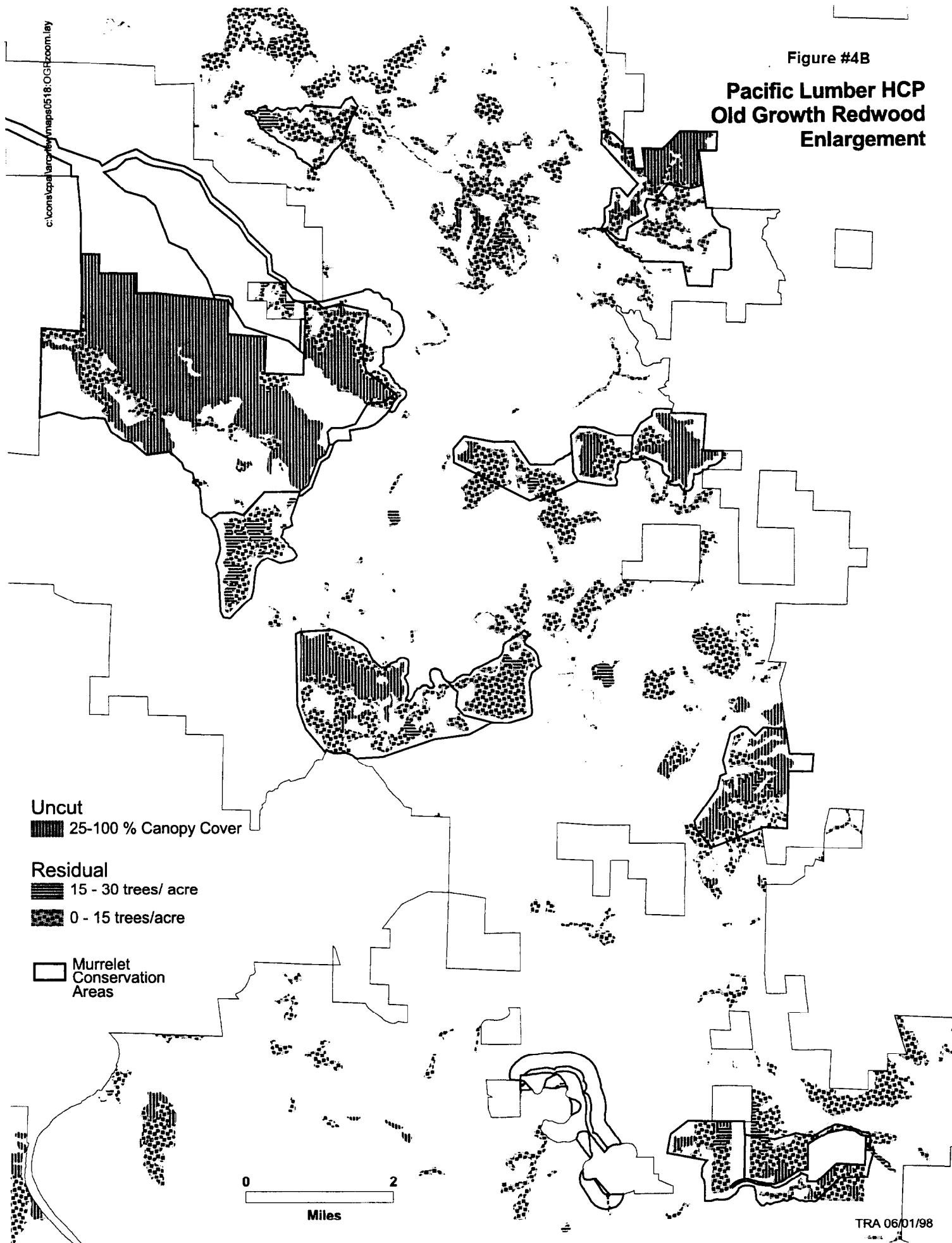


Figure #5A

**Pacific Lumber HCP  
Old Growth and  
Second Growth Forest**

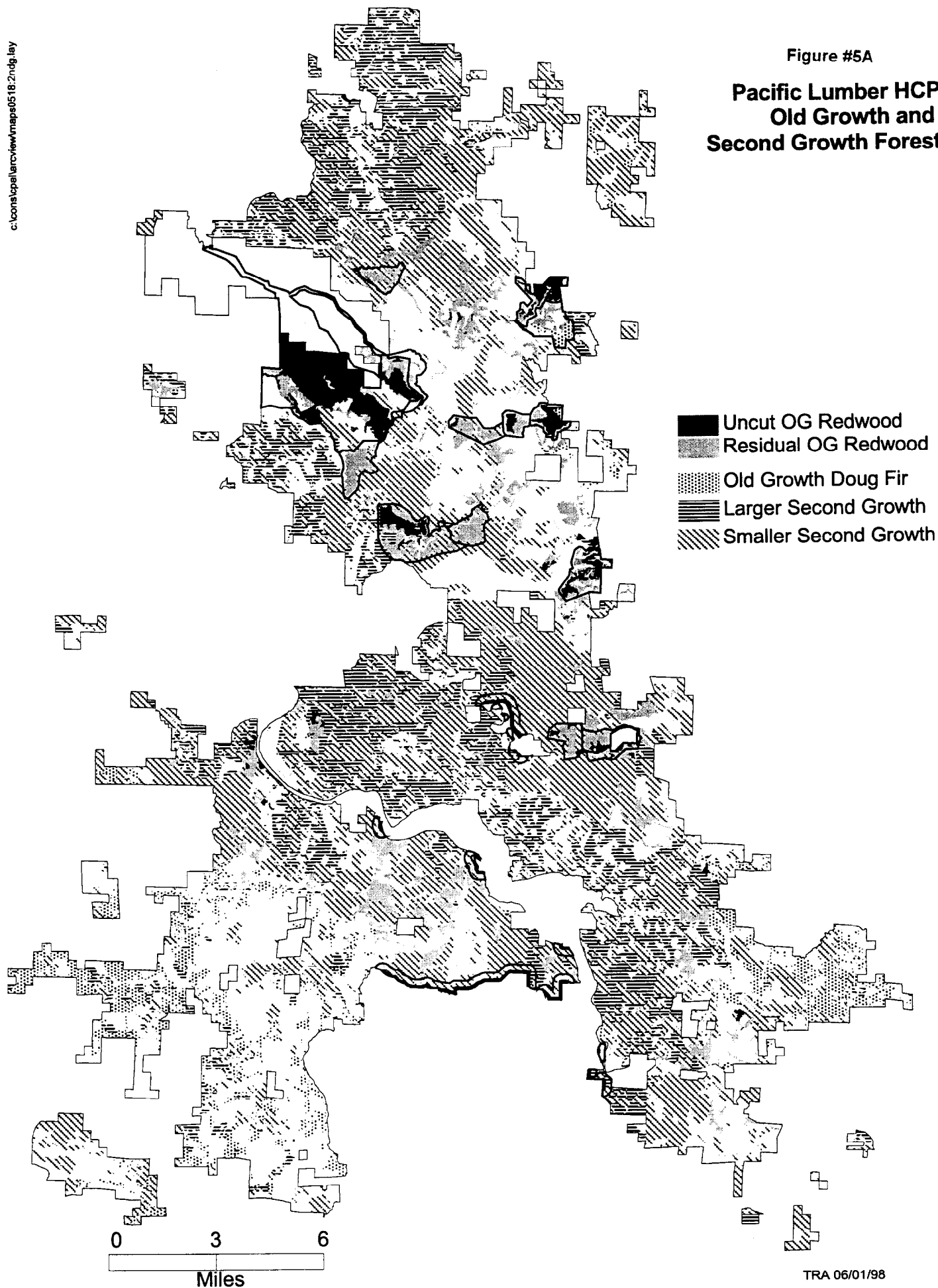


Figure #5B

**Pacific Lumber HCP  
Old Growth and  
Second Growth Forest  
Enlargement**

c:\const\cpal\arowiew\maps0518.2ndgz.lay

- Uncut OG Redwood
- Residual OG Redwood
- Old Growth Doug Fir
- Larger Second Growth
- Smaller Second Growth
- MCA

0 2  
Miles

Figure #6

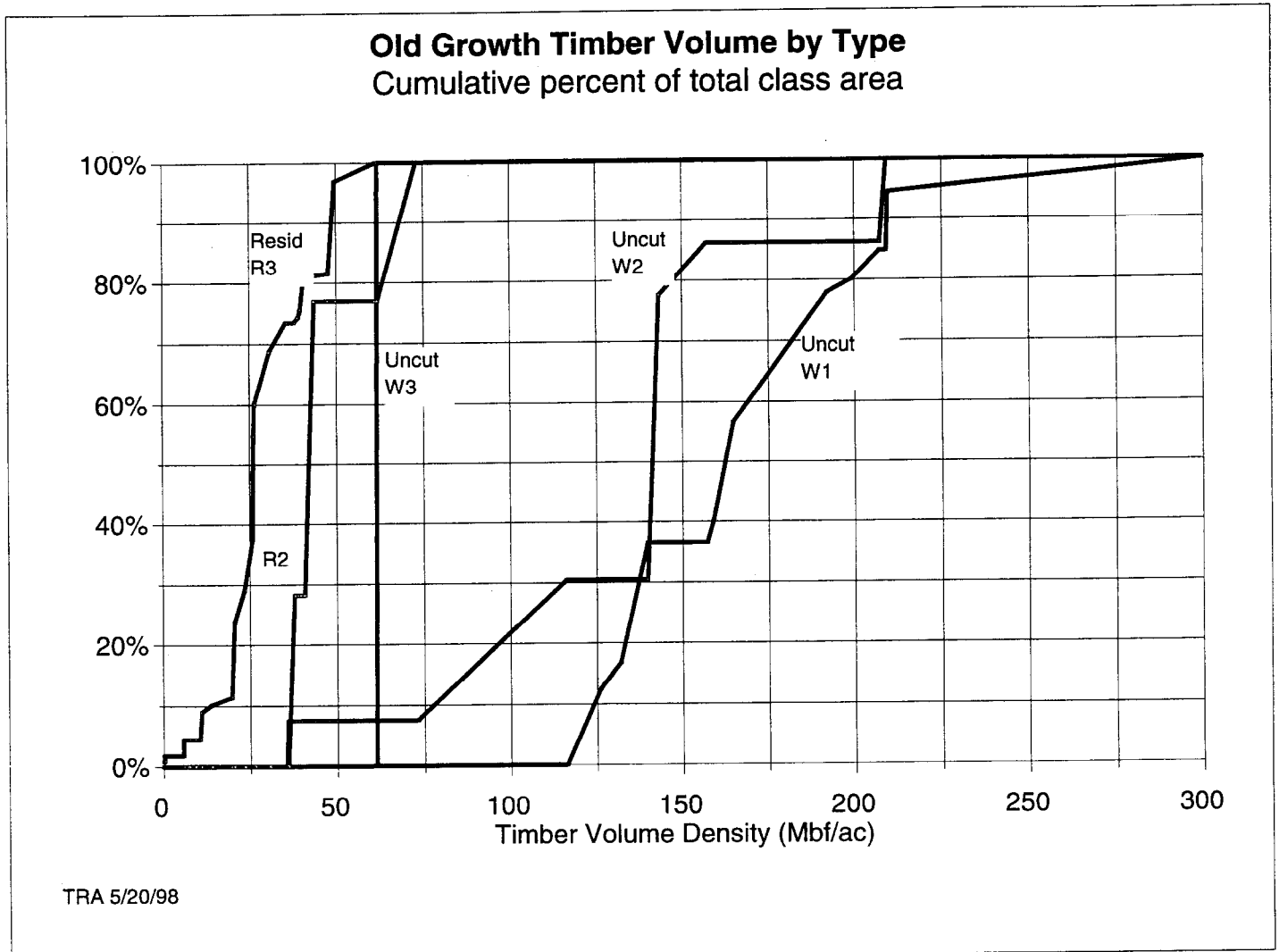


Figure #7A

**Pacific Lumber HCP  
Marbled Murrelet  
Survey Status**

**Station Results  
1993 - 1997**

**+** Occupied

**Not Occupied**

○ Present

◻ Not Detected

**Not Occupied  
Low Survey Effort**

× Present

△ Not Detected

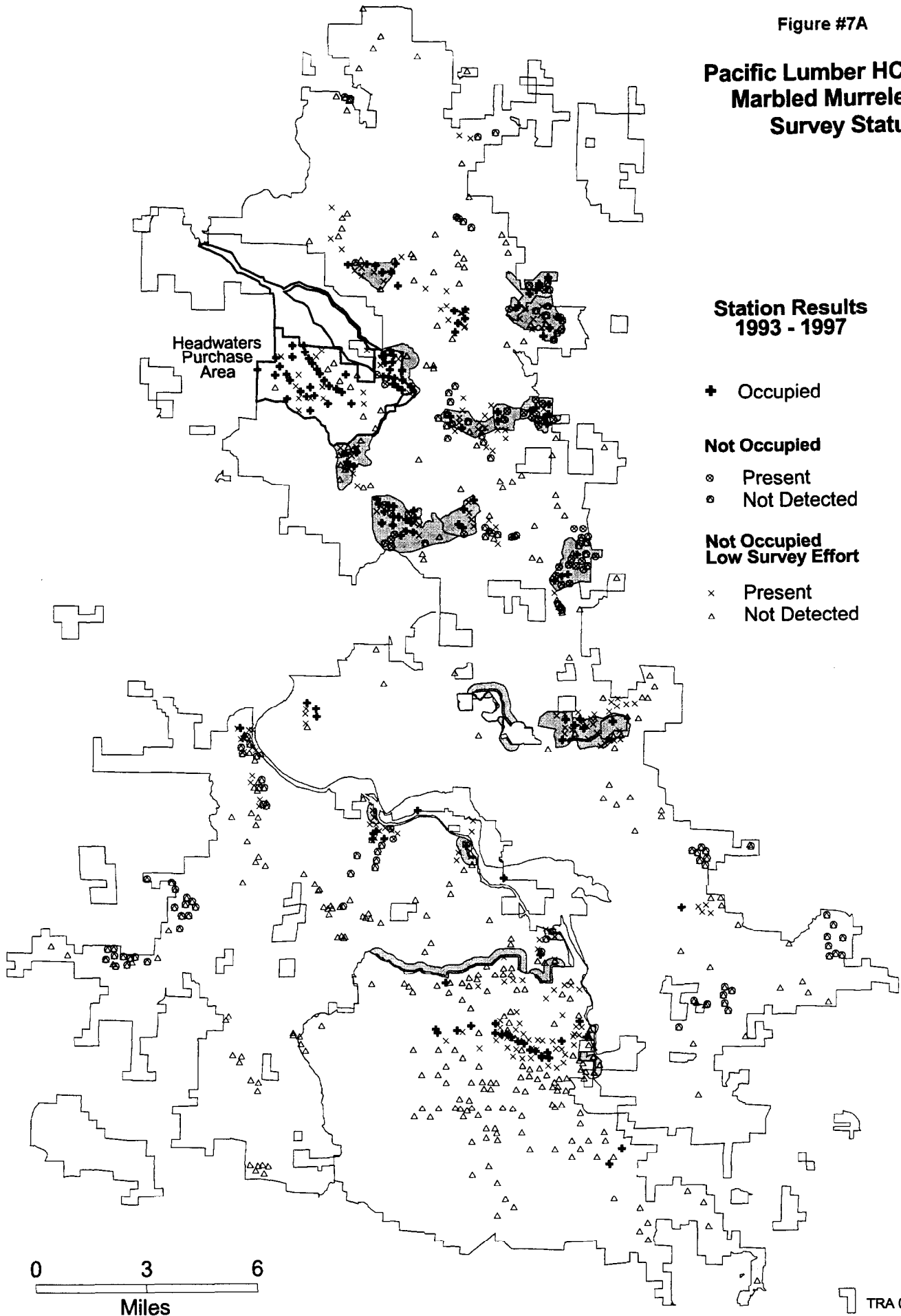


Figure #7B

**Pacific Lumber HCP  
Marbled Murrelet  
Survey  
Enlargement**

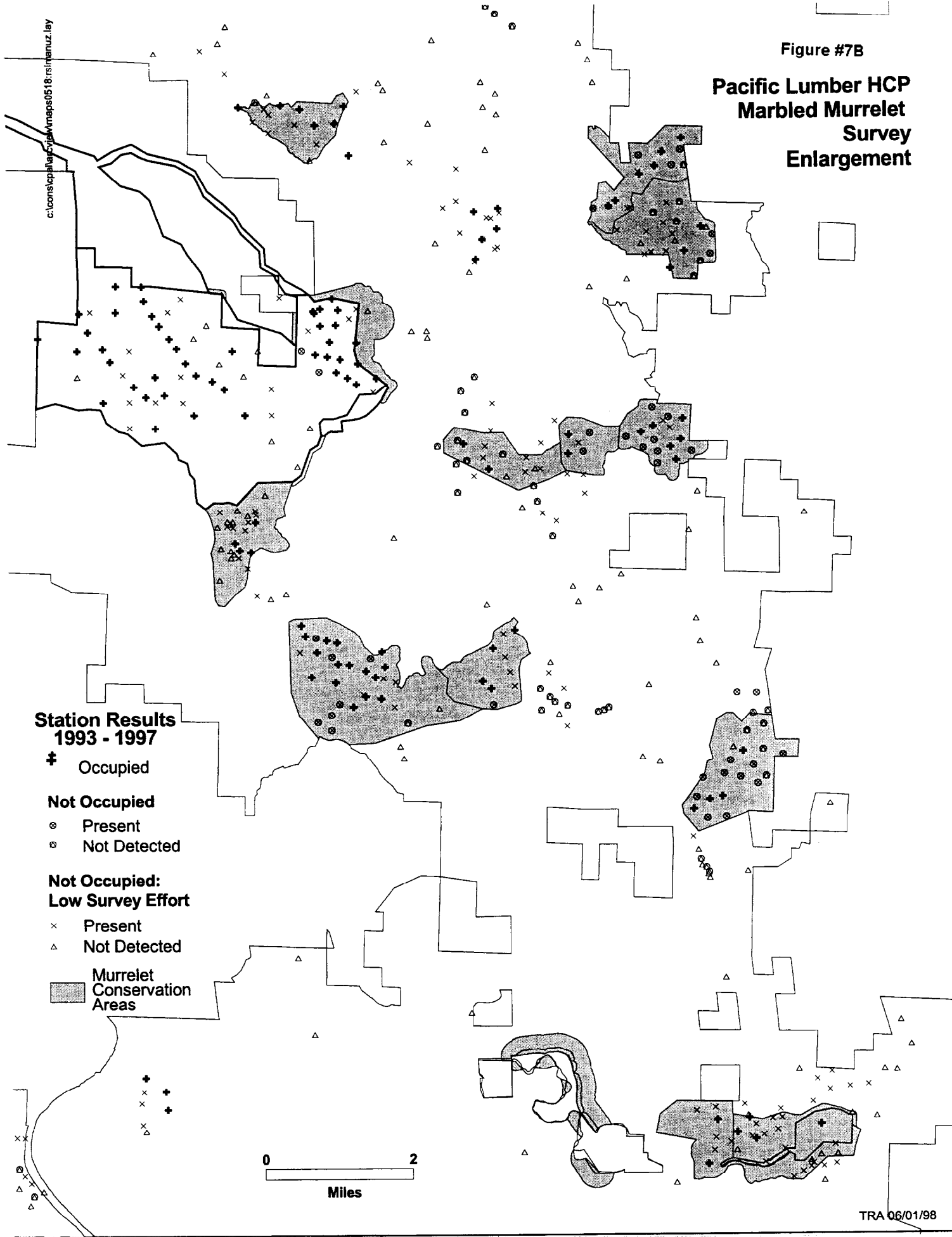




Figure #8A

**Pacific Lumber HCP  
Marbled Murrelet  
Survey Status  
Within 1/2 mile of  
Survey Stations**

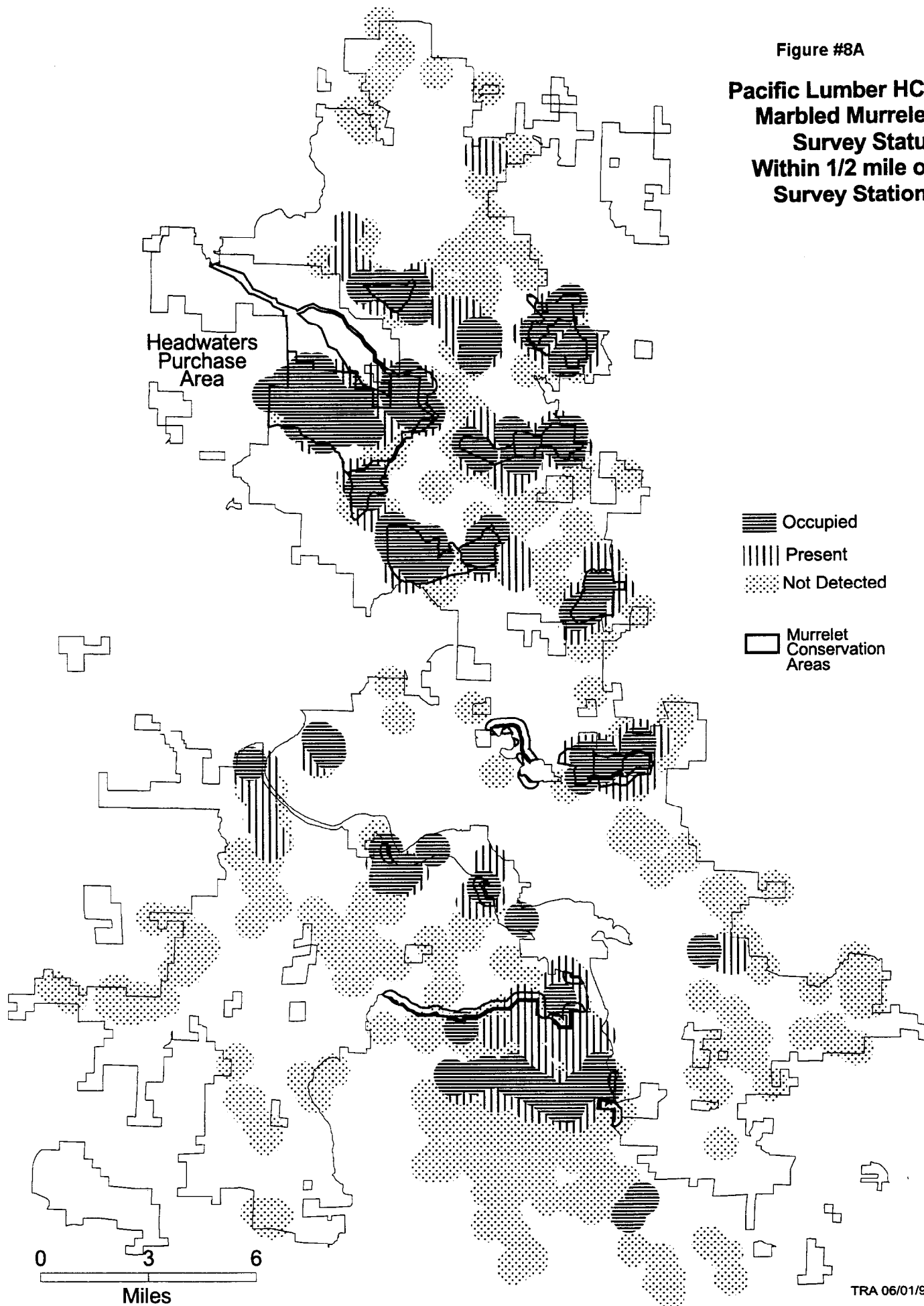
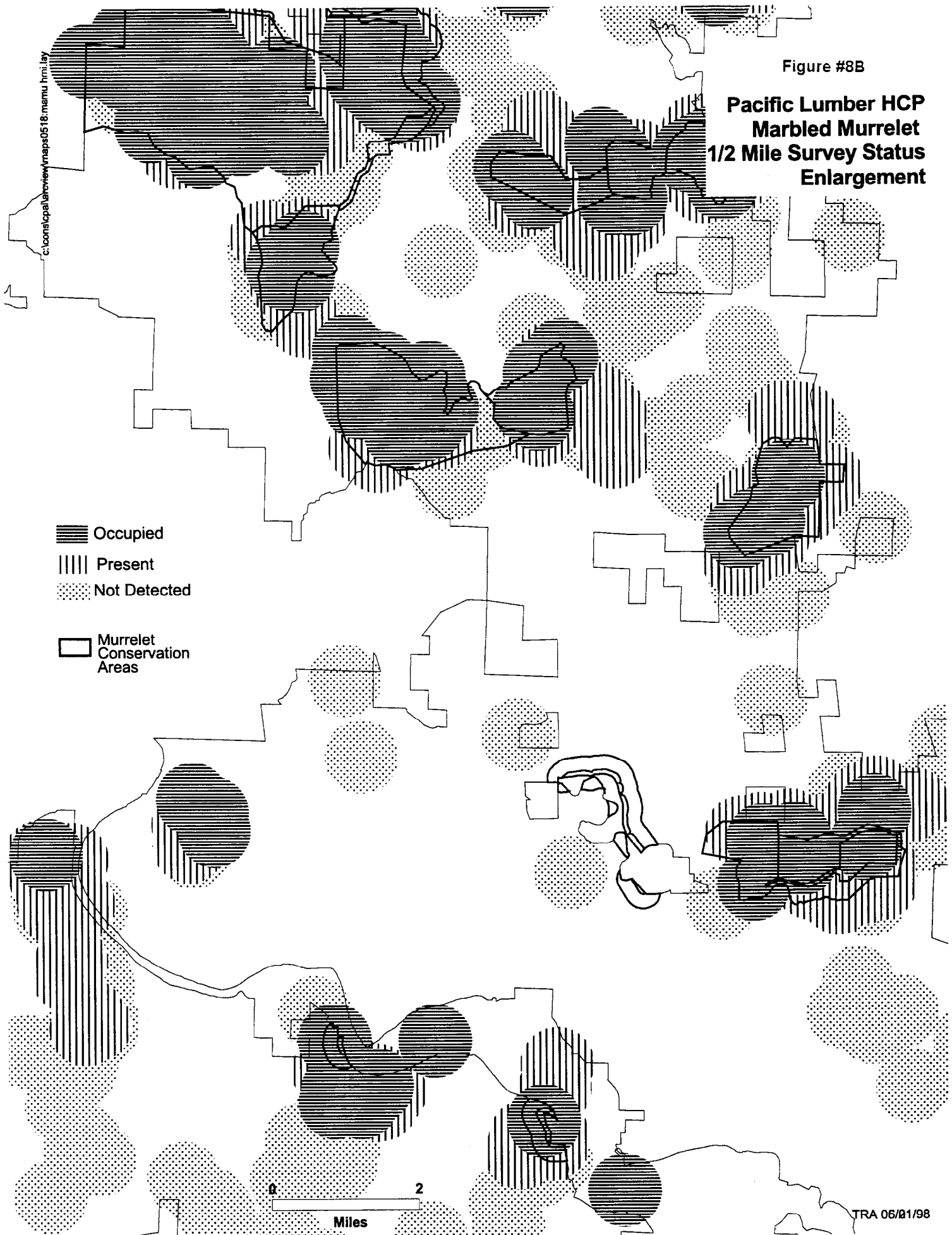


Figure #8B

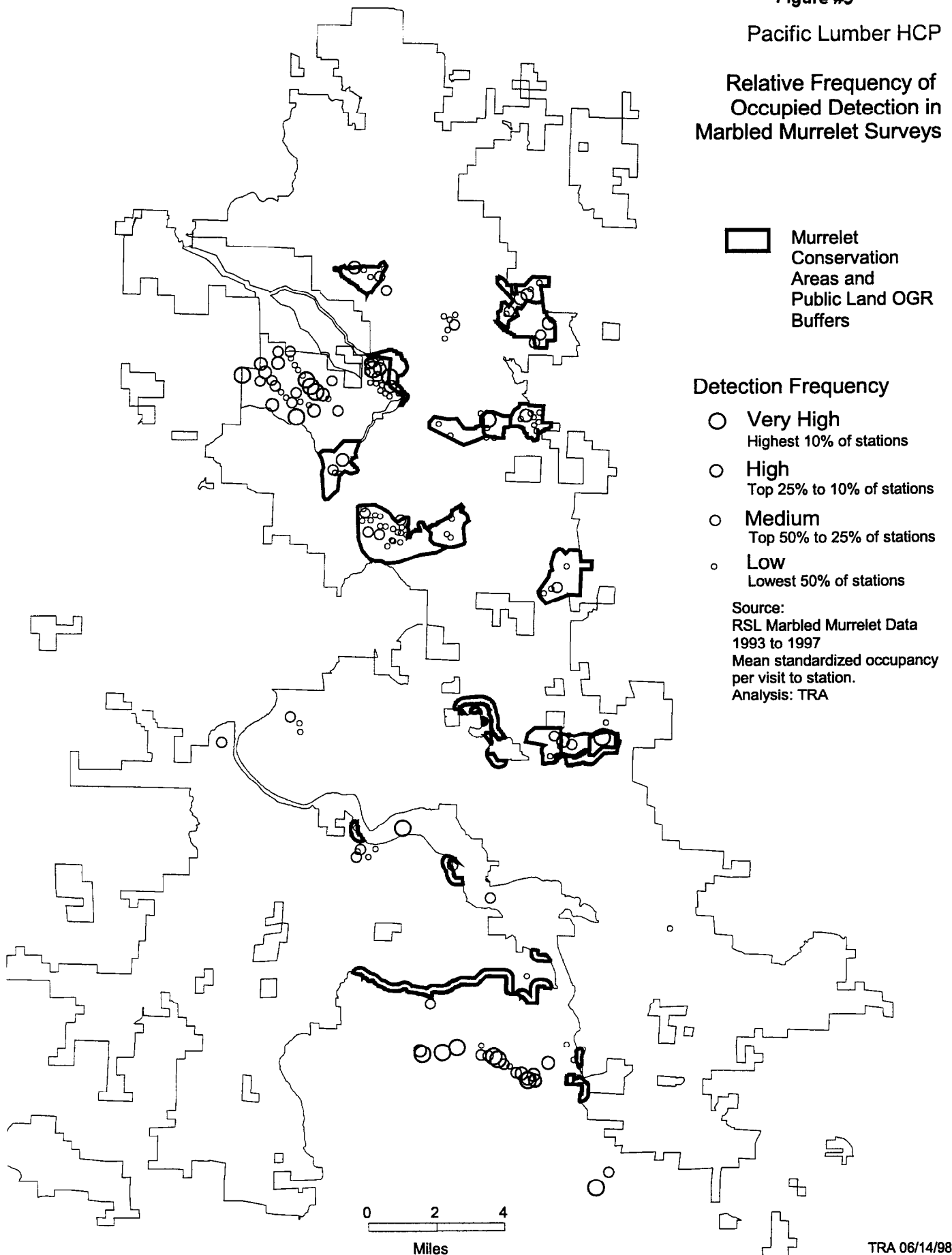
**Pacific Lumber HCP  
Marbled Murrelet  
1/2 Mile Survey Status  
Enlargement**



**Figure #9**

**Pacific Lumber HCP**

**Relative Frequency of  
Occupied Detection in  
Marbled Murrelet Surveys**



# AQUATIC PROPERLY FUNCTIONING CONDITION MATRIX a.k.a. Species Habitat Needs Matrix

March 20, 1997  
Work-In-Progress  
for the  
PACIFIC LUMBER COMPANY HABITAT CONSERVATION PLAN

- \* The Matrix displays a condition for the landscape which has been determined, using the best scientific information available, to be properly functioning in order to meet the habitat needs of aquatic species.
- \* The Matrix below is to be used for Class I and II watercourses; Class III watercourse properly functioning conditions are found in Attachment "F".
- \* All indicators are interrelated, many are interdependent, and should be viewed together as a functioning system.

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	REFERENCE	NOTES
Water Quality:	Temperature	11.6 - 14.6°C (53.2-58.2°F); MWAT 16.8°C (62.2°F) late summer juvenile rearing		May be lowered to meet amphibian needs. Refer to attachment "A" for information regarding methodology.
	Sediment/Turbidity	Refer to attachment "B" for Class I & II watercourses Refer to attachment "F" for Class III watercourses		High priority for research and monitoring to adjust for specific geologic formations and soil types on the north coast

**Aquatic Properly Functioning Condition**  
**March 20, 1997 Work-In-Progress**

	Chemical Contamination/ Nutrients	low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches; complies with Basin Plans	Clean Water Act and state regulations	Being further explored for appropriate verbiage and standard.
Habitat Access:	Physical Barriers	any man-made barriers present in watershed allow upstream and downstream fish passage at all flows		
Habitat Elements:	Substrate	Refer to attachment "B" for D-50, pebble count		
	Large Woody Debris	Refer to attachment "C" for Class I & II watercourses Refer to attachment "F" for Class III watercourses		Conditions for redwood dominated areas is being further explored; preliminary figures will be available soon.
	Pool Frequency	Refer to attachment "D" for pool frequency and attachment "C" for large woody debris		
	Pool Quality	Refer to attachment "D" and "C"; pools > 1 meter deep, based on minimum residual summer depth (holding pools), with good cover and cool water, minor reduction of pool volume by fine sediment		
	Off-channel Habitat	maintain existing backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)		

**Aquatic Properly Functioning Condition**  
**March 20, 1997 Work-In-Progress**

	"Hot Spots" and Refugia (important remnant habitat for sensitive aquatic species)	maintain existing habitat "hot spots" (good habitat in limited areas) and refugia (havens of habitat safety where populations have a high probability of serving periods of adversity) at the macro scale (e.g. intact reaches, drainage, etc.); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations	USDA 1993 (SAT Report)	
Channel Condition & Dynamics:	Width/Depth Ratio	maintain width/depth ratio in properly functioning streams, as determined by reaching and/or maintaining properly functioning conditions of other parameters; improve width/depth ratio in degraded streams		
	Streambank Condition	>90% stable; i.e., on average, less than 10% of banks are actively eroding		
	Floodplain Connectivity	maintain off-channel areas hydrologically linked to main channel; maintenance of overbank flows, wetland functions, riparian vegetation and succession; restore connectivity where feasible on ownership		
Flow/Hydrology:	Change in Peak/ Base Flows	watershed hydrography indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography		

**Aquatic Properly Functioning Condition**  
**March 20, 1997 Work-In-Progress**

	Increase in Drainage Network	zero or minimum increases in drainage network density due to roads ; zero increase in volume capacity in natural channels so as not to degrade channel conditions		
Watershed Conditions:	Road Management	Entire road network (including permanent, seasonal, temporary and abandoned (legacy) roads, landings and skid trails) are storm-proofed, armored or retired (stream crossings altered so as to prevent erosion, road blocked to prevent motorized use, etc.). All intact road surfaces and drainage facilities and structures receive at least annual inspection and additional inspection during use and wet periods for proper design and function. Proper design and function evaluated according to specific performance standards pertaining to sediment delivery, drainage network density and volume capacity of natural channels. All elements of the road network found, through inspection, to not meet or high probability of not meeting performance standards must be treated, relocated or retired.		
	Disturbance History			Further discussion warranted based on outcome of PalCo's response to SYP comments from agencies

**Aquatic Properly Functioning Condition**  
**March 20, 1997 Work-In-Progress**

<p><b>Riparian Buffer</b></p>	<p>For specifics refer to attachment "E" for Class I &amp; II watercourses. Refer to attachment "F" for Class III watercourses.</p> <p>The riparian buffer system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds. Includes buffers for known "hot spots" and refugia for sensitive aquatic species; percent similarity of riparian vegetation to the potential natural community/ composition is achieved</p>		
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Developed by staff in: National Marine Fisheries Service, Environmental Protection Agency, California Department of Fish and Game, California Department of Forestry and Fire Protection and North Coast Regional Water Quality Control Board

Compiled by: Vicki Campbell, National Marine Fisheries Service

Prepared for: Pacific Lumber Company habitat conservation planning effort

vick/palco/pimtrb3.320



ATA USE AND EVALUATION

For purposes of water quality assessment and management, temperature data is used to assess impacts on any beneficial water use(s). In the North Coast Region, attention is directed to the temperature requirements of cold water fishery resources, particularly anadromous fish populations, as this beneficial use is extremely sensitive to certain temperature conditions. Wide daily variations of temperatures and elevated water temperatures can cause significant impairment of the successful propagation, rearing and survival of anadromous fish populations.

Regional Water Board staff recommends using two references for evaluating stream temperatures:

Temperature Criteria for Freshwater Fish: Protocol and Procedures published by U.S. EPA in 1977.

Guidance for Evaluating and Recommending Temperatures Regimes to Protect Fish, Instream Flow Information Paper 28, Carl Armour, U.S. Fish and Wildlife Service, 1991.

Maximum Weekly Average Temperature Requirements (MWAT)

The MWAT is the mathematical mean of multiple, equally spaced, daily temperatures over a 7-day consecutive period. A minimum of two data are required to determine the MWAT: the "physiological optimum temperature" (OT) and the "upper ultimate incipient lethal temperature" (UUILT). While the OT can be measured for numerous physiological functions, growth appears to be the most sensitive function. The UUILT is the "breaking point" between the highest temperatures to which an animal can be acclimated and the lowest of the extreme upper temperatures that will kill the organism.

MWAT is calculated as follows:

$$MWAT = OT + \frac{UUILT - OT}{3}$$

OT = a reported optimal temperature for the particular life stage or function.

UUILT = the upper temperature that tolerance does not increase with increasing acclimation temperatures.

We have calculated a MWAT for juvenile coho for late summer rearing and found a narrow range of temperatures which are dependent on acclimation temperature:

<u>acclimation temperature</u>	<u>UUILT</u>	<u>OT</u>	<u>MWAT</u>
15°C	24°C	13.2°C	16.8°C
20°C	25°C	13.2°C	17.1°C
>23°C	25.8°C	13.2°C	17.4°C

The OT is the average of the preferred temperature range which is reported to be 11.8 C to 14.6 C (Reiser and Horn, 1979, Influence of Forest and Rangeland Management of Anadromous Fish Habitat in the Western United States and Canada, USDA Forest Service Technical Report PNW-96).

Draft Properly Functioning Conditions for Sediment Levels (3/20/97)

**Purpose of table:** Identify properly functioning salmonid habitat and other beneficial use target conditions relative to instream sediment levels and hillslope sediment delivery mechanisms on PL ownership. Sediment is one of several water quality and habitat variables used for evaluating watershed health and impacts of management proposals.

**Selection of Parameters and Targets:** The listed parameters are based on lab and field research conducted throughout the Pacific Northwest (as described in Chapman 1988, Bjorn and Reiser 1991 and others) as well as a limited amount of localized information from Northern California (Knopp 1993, Burns 1970). Baseline data for some of the parameters (e.g., V\*, pebble count) are not currently available for PL lands. PL may wish to incorporate those parameters into their monitoring program for future indication of sediment conditions and effectiveness of management actions. Ideally, additional research and monitoring data from Northern California will provide information from which to derive watershed-specific target conditions.

**Watershed Analysis and Interim Targets:** Given the natural variation in sediment loading between and within watersheds, a watershed inventory and analysis should determine existing sediment levels and identify reasonable interim targets, timeframes and management actions necessary to achieve long-term goals. A watershed analysis including some form of sediment budget, should clearly define baseline conditions and identify relative contributions of sediment from different natural and human-induced sources (e.g., mass wasting, surface erosion, roads, in-channel storage, etc.).

Biological impact/concern	Parameter	Numeric or narrative target	Reference	Recommended Method	Sampling locations
Decrease in embryo survival due to reduction in gravel permeability, pore space and dissolved oxygen	%fines <0.85mm	<11-16%	Based on research described in Peterson et al. (1992) for TFW, Chapman (1988) and Burns (1970) baseline data from S. Fork Yager	Valentine Protocols (1995) using McNeil core samplers	Pool/riffle breaks, <3% gradient
Entrapment of fry emerging from redds	%particles <6.35mm	<20-25% (Steelhead and Chinook)	Bjorn and Reiser (1991), McCuddin (1977)	same	same
Measure of spawning gravel quality	Geometric Mean Diameter	>20mm	Shirazi and Seim (1979)	Shirazi and Seim (1979)	n/a
Measure of pore size and permeability of spawning gravel	Fredle Index	>9 (coho)	Lotspeich and Everest (1981)	Lotspeich and Everest (1981)	n/a
Measure of rearing/adult holding habitat in pools	V*	<20%	Knopp (1993)	Lisle and Hilton (1992)	3rd order, <3% gradient streams
Measure of substrate rearing habitat quality	Pebble count (D50)	65-95mm	Knopp (1993)	Knopp (1993)	same

Suspended sediment potentially impacts migrating juvenile/adult salmon	Turbidity	No visible increase in turbidity due to timber operations in Class I, II, & III watercourses and inside ditches that discharge directly to watercourses.	Modified from Road Use Mitigation Memo by PL (May 20, 1996)		Class I, II, III watercourses and inside ditches that discharge directly to watercourses.
Measure of scour and fill of streambed sediments impacting incubation	Scour Chains	Trend toward less deposition	Nawa and Frissell (1993)	Nawa and Frissell (1993)	low gradient, low confinement
Hillslope sediment delivery mechanisms	Surface erosion and mass wasting from management activities	Zero net discharge of sediment in non-303(d) listed waterbodies  Net decrease in sediment delivery from management activities in 303(d) listed waterbodies (Numeric goal to be determined)			
Benthic macroinvertebrate production and diversity	Macroinvertebrate population and/or diversity indices	To be determined	U.S. EPA Rapid Bioassessment Protocols as adapted by CA DFG		

## References

- Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication 19:83-138.
- Burns, James 1970. Spawning bed sedimentation studies in northern California streams. Inland Fisheries Division, Calif. Dept. Fish and Game.
- Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society. Vol. 117, No. 1.
- Knopp, Christopher 1993. Testing indices of cold water fish habitat. North Coast Regional Water Quality Control Board in cooperation with the California Department of Forestry and Fire Protection.
- Lotspeich, F. B. and P. H. Everest 1981. A new method for reporting and interpreting textural composition of spawning gravel. U.S. Forest Service Research Note PNW-139.
- McCuddin, Michael 1977. Survival of salmon and trout embryos and fry in gravel-sand mixtures. Master's Thesis. University of Idaho, Moscow.
- Peterson, N. P., A. Hendry and T.P. Quinn 1992. Assessment of cumulative effects on salmonid habitat: some suggested parameters and target conditions. Prepared for the Washington Department of Natural Resources and The Cooperative Monitoring, Evaluation and Research Committee Timber/Fish/Wildlife Agreement. University of Washington, Seattle, Washington.
- Shirazi, M. A., W. K. Seim and D. H. Lewis 1981. Characterization of spawning gravel and stream system evaluation. Pages 227-278 in Proceedings from the conference on salmon spawning gravel: a renewable resource in the Pacific Northwest. Washington State University, Washington Water Research Center Report 39, Pullman. Originally published as EPA Report EPA-800/3-79-109.
- Valenti, Bradley 1993. Stream substrate quality for salmonids: guidelines for sampling, processing, and analysis. California Department of Forestry and Fire Protection, Santa Rosa.

Properly Functioning Condition for Large Woody Debris, including "Key Pieces"

not suitable for BLD Canal  
DRI, No Rock, some 2x  
3/3/97 argu... meeting

Relationship between channel width and mean for debris diameter, length and volume and the number of pieces of debris in old-growth  
Douglas-fir forest streams (from Bilby and Ward 1989; Fox 1994)  
Considered as good forest

Channel Width (feet)	Bilby and Ward				Fox "Key Pieces" 1/2			
	Debris per 100 feet <sub>n</sub>	Geometric mean debris diameter (inches) <sub>n</sub>	Geometric mean debris length (feet) <sub>n</sub>	Mean debris piece volume (cubic feet) <sub>n</sub>	Debris per 100 feet	Average debris diameter (inches)	Average length (feet)	Average debris piece volume (cubic feet)
15	16	14	18	13	3.3	16	27	35.3
20	12	16	20	26	2.5	22	32	88.3
25	9	17	22	38	2.0			
30	7	18	25	51	1.7			
35	6	19	27	63	1.4	25	59	211.9
40	5	21	29	75	1.2			
45	5	22	31	88	1.1			
50	4	23	33	100	1.0	28	78	317.8
55	4	25	35	113	1.0			
60	3	26	37	125	0.8			
65	3	27	40	137	0.8			

ATTENTION

- 1/  $\text{Log}_{10} \text{debris frequency}/100\text{ft} = -1.12 * (\text{log}_{10} \text{channel width in feet} * 0.3048) + 0.46 * 0.3048 * 100$
- 2/ Geometric mean diameter (in.) =  $[2.14(\text{channel width in feet} * 0.3048) + 26.43] / 2.54$
- 3/ Geometric mean length (ft.) =  $[0.43 * (\text{channel width in feet} * 0.3048) + 3.55] * 3.281$
- 4/ Mean debris piece volume(cu.ft) =  $[0.23(\text{channel width in feet} * 0.3048) - 0.67] * (3.281)^3$
- 5/ A "key piece" is defined as:

"...a log/and or root-wad that:

- 1) is independently stable in the stream bankfull width (not functionally held by another factor; i.e. pinned by another log, buried, trapped against a rock or bedform, etc.); and
  - 2) is retaining (or has the potential to retain ) other pieces of organic debris.
- Without this "Key piece", the retained organic debris will likely become mobilized in a high flow (approximately a  $\geq 10$ -year event) (Fox 1994)."

### References and notes

- Bilby, R.E. and J.W. Ward 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Transactions of the American Fisheries Society. 118:368-378.
- Fox, Martin 1994. Draft revisions of the WSA Fish Module Diagnostic Matrix: LWD assessment. Muckleshoot Indian Tribe Fisheries Department dated June 6, 1994.

wmc:2/22/97

## Properly Functioning Conditions for Pool Habitat

**Purpose of table:** Identify properly functioning pool habitat conditions that will provide juvenile rearing habitat, adult holding habitat, and, potentially, thermal and velocity refugia, during all seasons of freshwater residency.

**Approach for achieving goals:** Watershed analysis should determine existing pool habitat quantity and quality and the distribution of good pool habitat and its spatial relationship to key thermal refugia and spawning areas.

Biological Impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Loss of pool quantity: Loss of juvenile rearing habitat: Juveniles leave stream systems at smaller sizes/younger ages and are subject to greater mortality expressed by smaller return ratios. Loss of adult holding habitat: Deep pools that provide holding habitat particularly escape cover and resting areas for adults of runs that enter streams during low flows and mature in fresh water are lost, thus fewer, or none, of those adults, reproduce successfully	Number of pools per mile equivalent to pool to pool spacing based on bfs widths	In streams with gradients $\geq 3\%$ and average widths $< 10$ meters (based on Little Lost Man Creek).  Pool to pool spacing 1 pool per every 3 bfs channel widths on average (a/).	Keller et al. 1905  a/Grant et al. In press  a/Nakamura and Swanson 1993	Measure distance from point of maximum depth to point of maximum depth.	Response reaches in conjunction with sediment and water temperature. Probably downstream of tributary confluences (Klein 191) Advances in Hydro-Science and Engineering, Vol 1, Wang (ed)).
	Percent of stream surface area comprised of pool habitat	pool area $\geq 20\%$ of the total stream surface area,			
	Percent of number of pools associated with LWD	and $\geq 90\%$ of # of pools associated with LWD	Keller et al. 1995  b/Leopold et al. 1964		
	Number of pools per mile equivalent to pool to pool spacing based on bfs widths	In streams with average gradient $< 3\%$ and average widths $\leq 19$ meters (based on Prairie Creek).  Pool to pool spacing 1 pool per every 6 channel widths on average (b/).	b/Keller and Melhorn 1978  b/Nakamura and Swanson 1993		
	Percent of stream surface area	pool area $\geq 25\%$ of the total stream			

ATTACHMENT 1

	comprised of pool habitat	surface area, 50% of the stream surface area composed of pool habitats (c/)	Peterson et al, 1992		
	Percent of number of pools associated with LWD	50% of # of pools associated with LWD			
Loss of summer refugia: Fish experience increased predation and potentially thermal stress resulting in decreased rates of survival. Loss of winter refugia: Fish that can not escape from high velocities during high winter flows can be flushed from the system resulting in smaller return ratios, higher mortality from stress (turbidity, starvation) can occur	Maximum depth  Volume  Cover	>=3 feet maximum depth,  V* -- (see sediment table)  The assumption is made that if LWD levels, bank stability, and riparian stand conditions are met, cover will be adequate	Platts 1983,	Residual maximum pool depth during summer low flows.	same

## Notes:

Beschta, R.L. and W.S. Platts. 1986. Morphological features of small streams: Significance and function. Water Resources Bulletin, Vol. 22, no. 3, P. 369 - 378.

-Primary and secondary pools...a variety is needed for various age-classes

-Nearly 90% of the pool-riffle sequences may consist of channel reaches 3 to 9 channel widths in length.

-Thus the size, frequency, distribution, and quality of pools in a stream depend upon the mechanisms of formation and other characteristics such as size of channels substrates, erodability of banks, and depth of flow.

Grant, Swanson, and Wolman (GSA Bulletin manuscript in review)

-Richards (1978 a,b) and Milne (1982a) corroborated that pool-to-pool spacing is a function of channel width.

-The frequency distribution of pool-to-pool spacing in boulder bedded streams peaked between 2-4 active channel widths, though some streams had bimodal distribution with a primary peak at three and a secondary peak at 8 (with a range as high as 45).

-Church and Gilbert (1975) observed that small streams and torrents seemed to have dominant wavelengths of 2- 3.5 times the channel width.

-Müne (1982a) noted that bed form spacings can easily be upset by variation in sediment mixtures and the presence of 'residual' bedload...which disallowed the high bed-transport rates that produce regular repeating distances.

-Field observations suggest that distinct channel units do not form where sediment supply is high and channels are wide. Instead, braiding occurs and channel bed morphology is characterized by long, featureless rapids (Fahnestock, 1963; Ikeda, 1975).

Keller, E.A., A. MacDonald, T. Tally, and N.J. Merril. 1995. Effects of large organic debris on channel morphology and sediment storage in selected tributaries of Redwood Creek, northwestern California. IN Geomorphic processes and aquatic habitat in the Redwood Creek basin, northwestern California. U.S. Geological Survey Professional Paper 1454. Nolan, K.M., H.M. Kelsey, and D.C. Mairon, (ed.s). U.S. Gov. Print. Office, Washington.

Keller, E.A. and W.N. Melhorn. 1978. Rhythmic spacing and origin of pools and riffles. Geo. Soc. of Am. Bul. V. 89, p. 723 - 730.

-70% of the variability of spacing in pools can be explained by variability in channel width.

-Alluvial and bedrock channels in different climates had pool spacing that was statistically from the same population.

-Pool to pool spacing is determined by measuring the distance between the maximum depths of adjacent pools.

-Channel width is measured at a point on the riffle between pools where the cross-channel profile is nearly symmetrical and the banks well defined, and is delineated by the width of bed material or the distance between major breaks in slope from the bottom of the channel to the banks of the channel.

-The average spacing is six times the channel width...the conclusion of Leopold and others (1964) that pools are spaced approximately five to seven times the channel width.

Peterson, N.P., A. Hendry, and Dr. T.P. Quinn. 1992. Assessment of cumulative effects on salmonid habitat: Some suggested parameters and target conditions. Prepared for the Washington Dept. of Natural Resources and the Cooperative Monitoring, Evaluation and Research Committee Timber/Fish/Wildlife Agreement. TFW-F3-92-001. Center for Streamside Studies, UW, Seattle, WA 98195.

Nakamura, F., and F.J. Swanson. 1993. Effects of coarse woody debris on morphology and sediment storage of a mountain stream system in western Oregon. Earth Surf. Proc. and Landf. v.18, p. 43-61.

[see also: Elser 1968, Lewis 1969,]



## Properly Functioning Condition for Riparian Forests and Buffer

Purpose of table: Identify properly functioning riparian zone conditions relative to producing targeted levels of large woody debris, maintaining targeted temperature regimes, mitigating potential sediment effects from materials delivered through overland flow and bank cutting, and late-successional forest habitat. The latter includes retention of key habitat elements, including large snags, large woody debris on the forest floor and large sized trees.

Approach for achieving goals: Watershed analysis should determine existing riparian zone stand structure and composition as well as potential to provide key watershed inputs including large woody debris, stream-bank stability and to function in maintaining targeted temperature regimes and late-successional forest habitat structure and composition.

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Low large woody debris (LWD) recruitment potential	Quadratic mean tree diameter (QMD) (/1) of fully-stocked stands	$\geq 24$ in. dbh <u>or</u> $\geq$ targeted ave. "key piece" LWD diameter (/2), whichever is greater	Bilby and Ward 1989, Ca. Board of Forestry 1997, Fox 1994	USDA Forest Service 1995	distal to outer margin of channel migration zone (/3)
	Ave. number of large trees per acre by dbh class	<u>Redwood:</u> 23.8 > 32 in. $\frac{23.8}{17.4}$ 17.4 > 40 in. $\frac{17.4}{11.0}$	Redwood (SAF Type 232)	same	same
		<u>Douglas-fir:</u> (/x) 18.5, 16.3 > 30 in. $\frac{18.5}{11.0}$ 11.0, 9.0 > 40 in. $\frac{9.0}{11.0}$	Douglas-fir/mixed evergreen (SAF Type 234)		
High mid- to late-summer water temperature regimes	Overstory tree canopy closure	Ave. of at least 85 percent overstory tree canopy closure (/4)	Flossi and Reynolds 1994 <i>20% canopy closure of S.F. BA</i>	USDA Forest Service 1995; Ganey and Block 1994	same, assessed for every 200-ft section of riparian zone, on each side of stream

Properly Functioning Condition for Riparian Forests and Buffer (continued)

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Maintain large downed woody debris for near-stream habitat complexity and filter strip function	a) Ave. tons of large organic debris per acre;	a) <u>redwood</u> : to be determined from samples of old-growth redwood forest riparian zones <u>Douglas-fir</u> : 24.2 tons per acre of materials greater than 10 inches on small end	Jimerson et al. 1996 [DOUG-FIR]	USDA Forest Service 1995	distal to outer margin of channel migration zone.
	b) Ave. number of large pieces of wood on ground per acre	b) <u>redwood</u> : to be determined from samples of old-growth redwood forest riparian zones <u>Douglas-fir</u> : >30" 3.8 >20" & <30" 6.9 >15" & <20" 6.3 >10" & <15" 12.7	Jimerson et al. 1996 [DOUG-FIR]		
	c) percent surface cover and undisturbed area	c) at least <del>25</del> 95 percent	Ca. Board of Forestry 1997 HILLSLOPE		

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Properly Functioning Condition for Riparian Forests and Buffer (continued)

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Maintain large snags for near-stream habitat complexity and to supplement potential LWD	Snags per acre $\geq 30$ in. dbh	Ave. of at least three snags per acre $\geq 30$ in. dbh (/5)	Richter 1993	same	same, assessed over at most 10 acres of riparian zone (/6)
Loss of vegetative cover and sediment effects from stream bank erosion	Stream bank stability	"Good" to "Excellent" stream bank stability afforded by root systems of large trees supplemented by large wood and shrub layer	Pfankuch 1978 • REFER TO riparian stream bank stability assessment	Pfankuch, 1978	Lower and upper banks (Pfankuch 1978) and channel migration zone

/1 Only trees  $> 5$  in. dbh are included in QMD calculations. Confidence interval of  $\pm 5$  percent at 95 percent.

/2 See tables under "Targeted Conditions for Large Woody Debris."

/3 See channel migration zone definition in "Aquatic Conservation Strategy" (USDA and USDI 1994, "Record of decision.")

/4 Increase to greater than 90 percent where temperature regimes do not meet the criteria for "properly functioning."

/5 Assuming a 100-foot-wide zone on both sides, this would be equivalent to  $\geq 1.4$  large snags of this size per 100 feet of stream.

/6 Assuming a 100-foot-wide zone, this would be equivalent to an assessment per 0.8 miles of stream.

→ corrections from 3/3/97 meeting.

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wmc:2/23/97

### Properly Functioning Condition for Class III Watercourses

**Purpose of table:** Identify properly functioning conditions within zones containing class III watercourses. These conditions relate to producing targeted levels of large woody debris for terrestrial species and for delivery to aquatic habitats, mitigating potential sediment effects to class I and II habitats and associated species from sediment delivered through class III watercourses and producing key habitat elements. The latter includes retention and production of large snags, large woody debris on the forest floor and large trees.

**Approach for achieving goals:** Watershed analysis should determine the existing stand structure and composition of trees, snags and downed woody materials and other elements along class III watercourses, evaluate the risk of sediment effects to aquatic species (including salmonids, salamanders and frogs) from timber operations near class III watercourses, evaluate the potential to provide key watershed inputs including large woody debris, stream-bank stability and to function in maintaining targeted hill slope habitat structure and composition.

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Low snag and large woody debris (LWD) recruitment potential	Ave. number of green trees per acre by dbh class	All species: (/1) 3 > 11 in., < 15 in. 3 > 15 in., < 30 in. 3 > 30 in.	Bisson et al. 1997, Cline et al. 1980, Freel, 1991, Richter, 1993	USDA Forest Service 1995	within "equipment exclusion zone" (/2 )
Maintain large snags for near-stream habitat complexity and to supplement potential LWD	"Soft" and "hard" snags per acre	All species: 1, 1 > 11 in. < 15 in. 1, 1 > 15 in., < 30 in. 1, 1 > 30 in.	Cline et al., 1980, Freel, 1991, Richter, 1993	same	same

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Maintain large downed woody debris for habitat complexity and filter strip function	a) Ave. tons of large organic debris per acre;	a) <u>redwood</u> : to be determined from samples of old-growth redwood forests <u>Douglas-fir</u> : 24.2 tons per acre of materials greater than 10 inches on small end	Jimerson et al. 1996	USDA Forest Service 1995	within equipment exclusion zone
	b) Ave. number of large pieces of wood on ground per acre	b) <u>redwood</u> : to be determined from samples of old-growth redwood forests <u>Douglas-fir</u> : >30" 3.8 >20"&<30" 6.9 >15"&<20" 6.3 >10"&<15" 12.7	Jimerson et al. 1996		
	c) Percent surface vegetative cover	c) at least 95 percent surface vegetation	Ca. Board of Forestry hill slope monitoring study (/3)		

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Loss of vegetative cover and sediment effects from stream bank erosion	Stream bank stability	"Good" to "Excellent" stream bank stability afforded by root systems of large trees supplemented by large wood and shrub layer	Pfankuch 1978	Pfankuch, 1978	Lower and upper banks (Pfankuch 1978)

/1 This number of trees in each size class would be permanently marked for retention prior to each harvest entry.

/2 Equipment exclusion zones will be established along all class III watercourses. Zone widths will vary according to slope class, silvicultural prescription, yarding method and method of site preparation, slope location (e.g., upslope vs. "inner gorge") and downstream resources to be protected.

/3 Personal communications from Peter H. Cafferata, California Department of Forestry and Fire Protection, March 3, 1997 and based on information obtained through the Hill slope Monitoring Study funded by the California Board of Forestry.

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